Feasibility Report Appendixes

December 1991

American River Watershed Investigation, California

VOLUME 7 – APPENDIX S
PART 2

US Army Corps
of Engineers

Sacramento District
South Pacific Division

American River Watershed Investigation, California

FEASIBILITY REPORT

LIST OF APPENDIXES

American River Watershed Investigation, California

APPENDIX S

PART 2

Fish and Wildlife Coordination Act Report (Lower American River, Natomas Area)

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

AMERICAN RIVER WATERSHED INVESTIGATION

LOWER AMERICAN RIVER AREA

SUBSTANTIATING REPORT

VOLUME II

REGION ONE

NOVEMBER 1991

Substantiating Report

Lower American River Area

November 1991

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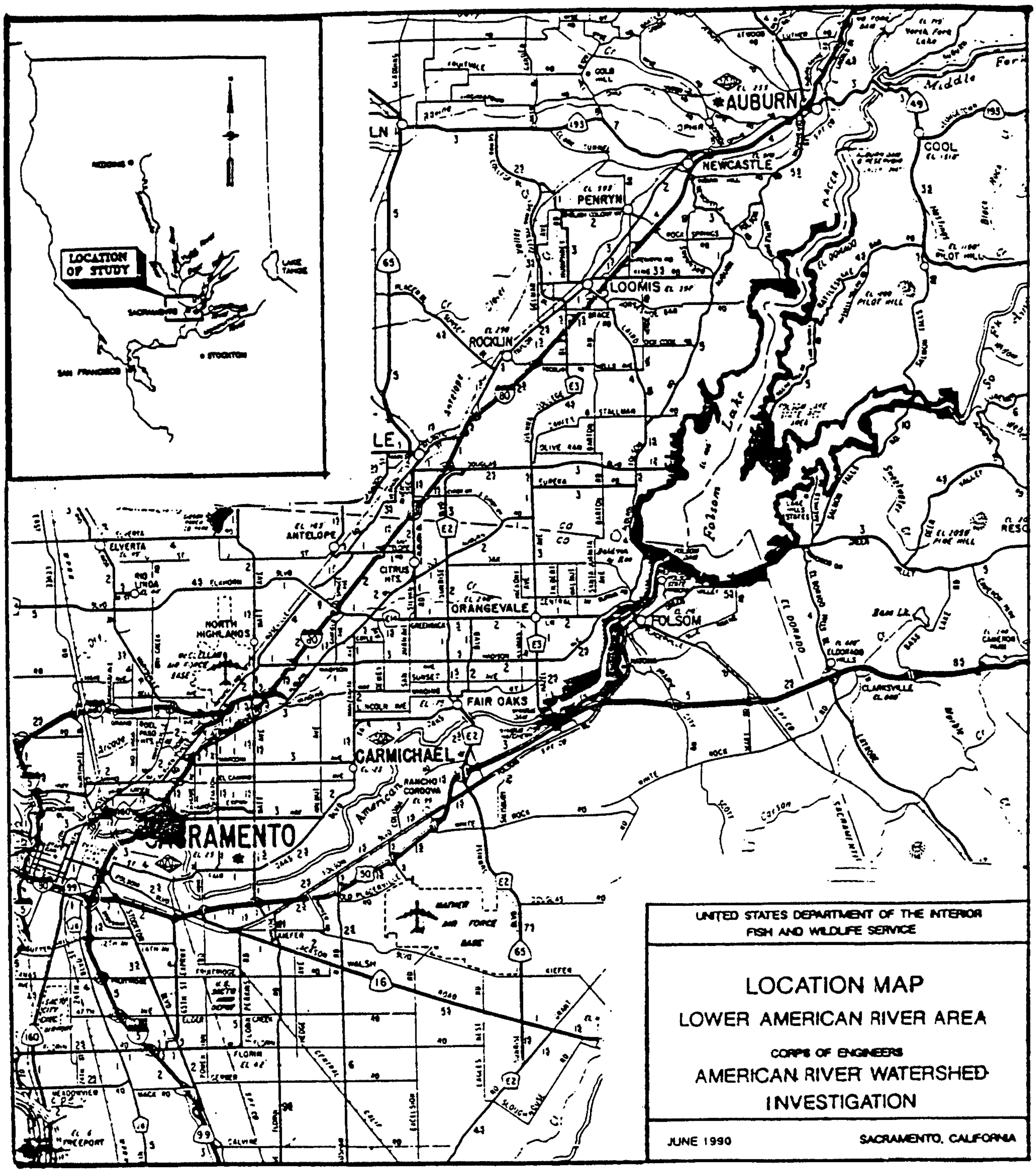
DESCRIPTION OF THE AREA

Originating in the Sierra Nevada, the North and Middle Forks of the American River join just upstream of the city of Auburn (Figure 1). From the North and Middle Forks confluence, the river flows past Auburn before entering Folsom Lake. Flows are released from Folsom Dam into Lake Natoma, which serves primarily as a reregulating reservoir. From Nimbus Dam, water is released downstream into the lower American River. It then flows through the American River Parkway (Figure 2), located in the densely populated Sacramento metropolitan area, for a distance of 23 miles before reaching its confluence with the Sacramento River. The average annual runoff is about 2.7 million acre-feet. The annual flow regime of the river, however, has changed significantly since construction of Folsom and Nimbus Dams in 1955.

Nimbus Salmon and Steelhead Hatchery is located just below Nimbus Dam (Figure 3). Built in the early 1950's to compensate impacts of the Folsom project, it is operated by the California Department of Fish and Game under contract with the Federal Government.

The lower American River floodplain is about 4,800 acres in size with an additional 4,000 acres of undeveloped adjacent lands. Of the 8,800 acres, about 5,000 acres are administered by Sacramento County as the American River Parkway (Figure 2). The parkway supports over 5 million visitor-use days annually with an estimated nonmarket value of $96 million (California Department of Fish and Game 1986), making it a very valuable regional asset.

Beyond the approximately 8,800 acres of undeveloped lands is the densely populated Sacramento metropolitan area. The river and adjacent undeveloped lands provide a natural and serene landscape, an escape for many residents from hectic city life. The floodplain is characterized by riparian vegetation, ponds, grassland, and dredger tailings. Most of the river is bounded by offset flood control levees (Figure 4) that are designed to contain floodflows up to 115,000 cubic feet per second (cfs). The lower river in its upper reaches is bounded in part by steep bluffs and hills of 50 feet or more in height. The river drops about 65 feet in elevation between Nimbus Dam and its confluence with the Sacramento River. The channel in the upper reaches consists of extensive gravels and cobbles, while downstream it is mostly sand and gravel. During high flow events, the lower reaches are influenced by Sacramento River backwater as far upstream as Watt Avenue, a distance of 10 miles.



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

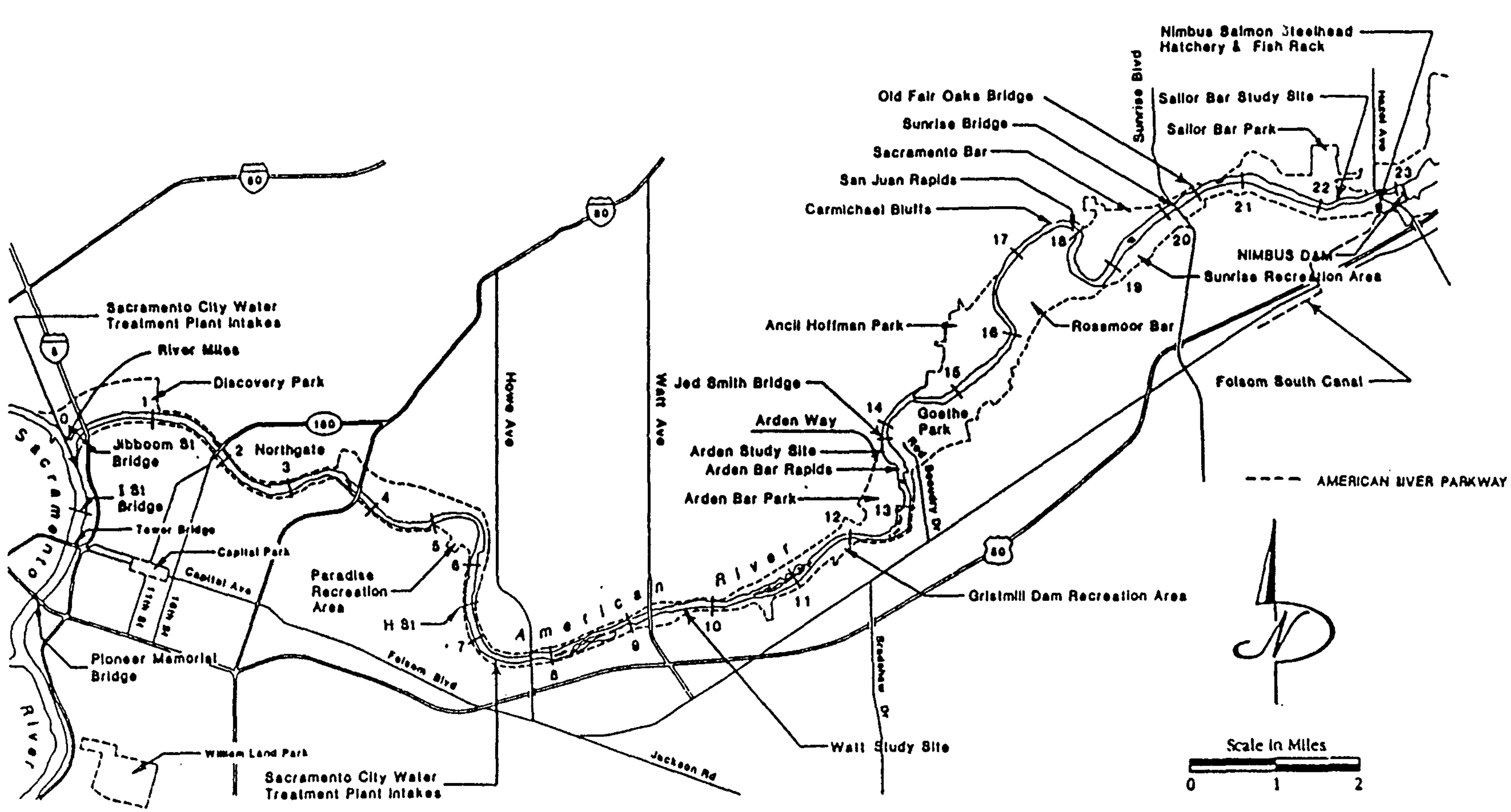
LOCATION MAP
LOWER AMERICAN RIVER AREA

CORPS OF ENGINEERS
AMERICAN RIVER WATERSHED INVESTIGATION

JUNE 1990 SACRAMENTO, CALIFORNIA

ADAPTED FROM CALIFORNIA STATE AUTOMOBILE ASSOCIATION MAP

FIGURE 1.



LOWER AMERICAN RIVER PROJECT AREA

SOURCE D.W. KELLY 1986

FIGURE 2.

FIGURE 3. NIMBUS SALMON AND STEELHEAD HATCHERY

FIGURE 4. OFFSET LEVEES

Significant population growth is occurring in, and adjacent to, the city of Sacramento, in the city of Folsom, and in the area surrounding Folsom Lake. This growth is expected to continue into the foreseeable future.

The lower American River has been part of the State Wild and Scenic Rivers System since 1972 and the National Wild and Scenic Rivers System since 1981, with "recreational" status. The river's exceptional anadromous fishery and recreational values were reasons for its inclusion. Under Federal classification, activities such as Federal construction, assistance, or licensing of water projects "adversely affecting the characteristics qualifying the river for the national system" are prohibited.

In order to protect the valuable instream resources of the river, three instream flow standards have been set. The 1958, the California State Water Resources Control Board's Decision 893 established the lower limits for flow releases from Nimbus Dam. Thus, the U.S. Bureau of Reclamation is legally required to make releases no less than 250 cfs from January 1 through September 14, and 500 cfs from September 15 through December 31 for salmon spawning. In 1972, a new minimum flow schedule was mandated for the then-proposed Auburn-Folsom South Project: Decision 1400 would require flows of at least 800 cfs from July 16 through October 14, and 1250 cfs from October 15 through July 15 should the project be constructed. Later, during the Environmental Defense Fund et al. vs. East Bay Municipal Utility District (EBMUD) lawsuit, the county of Sacramento recommended flows representing the minimums consistent with the avoidance of permanent impairment of the American River Parkway's recreational values. These flows range between 2,000 and 3,000 cfs. Based on hydrologic studies conducted by the State Board and considering only EBMUD's right of diversion at Nimbus Dam, minimum flows of 1250 cfs from October 15 through July 14, and 800 cfs from July 15 through October 14 were recommended to protect the instream fishery of the lower American River between Nimbus Dam and the American River Water Treatment Plant. Hence, EBMUD would not be allowed to divert American River water via the Folsom-South Canal during any period when the applicable flow level could not be met (Figures 5 and 6). In May 1989, a Preliminary Tentative Decision was rendered in the lawsuit over water diversions from Folsom Reservoir. The court decision states that EBMUD may divert 150,000 acre-feet annually only if the following instream flow conditions are met: 2,000 cfs from October 15 through February; 3,000 cfs from March through June; and 1,750 cfs from July through October 15 (Superior Court of California, Alameda Co. 1989) (Appendix D).

Although the Preliminary Tentative Decision insures that EBMUD will only be permitted to divert water in excess of defined

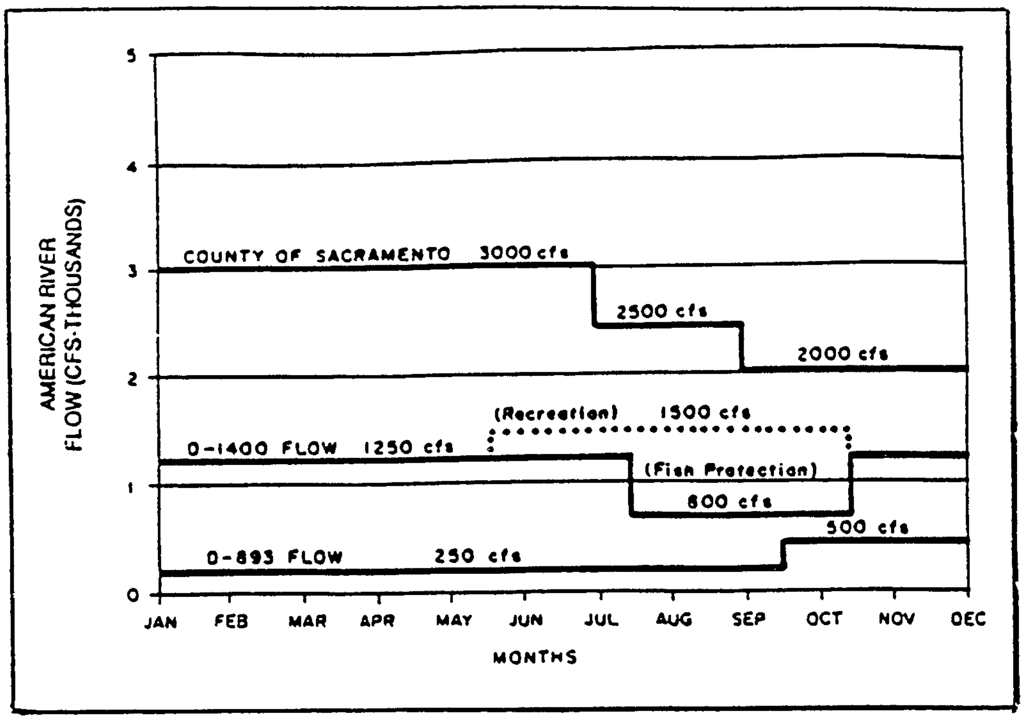


FIGURE 5: Lower American River Instream Flow Levels

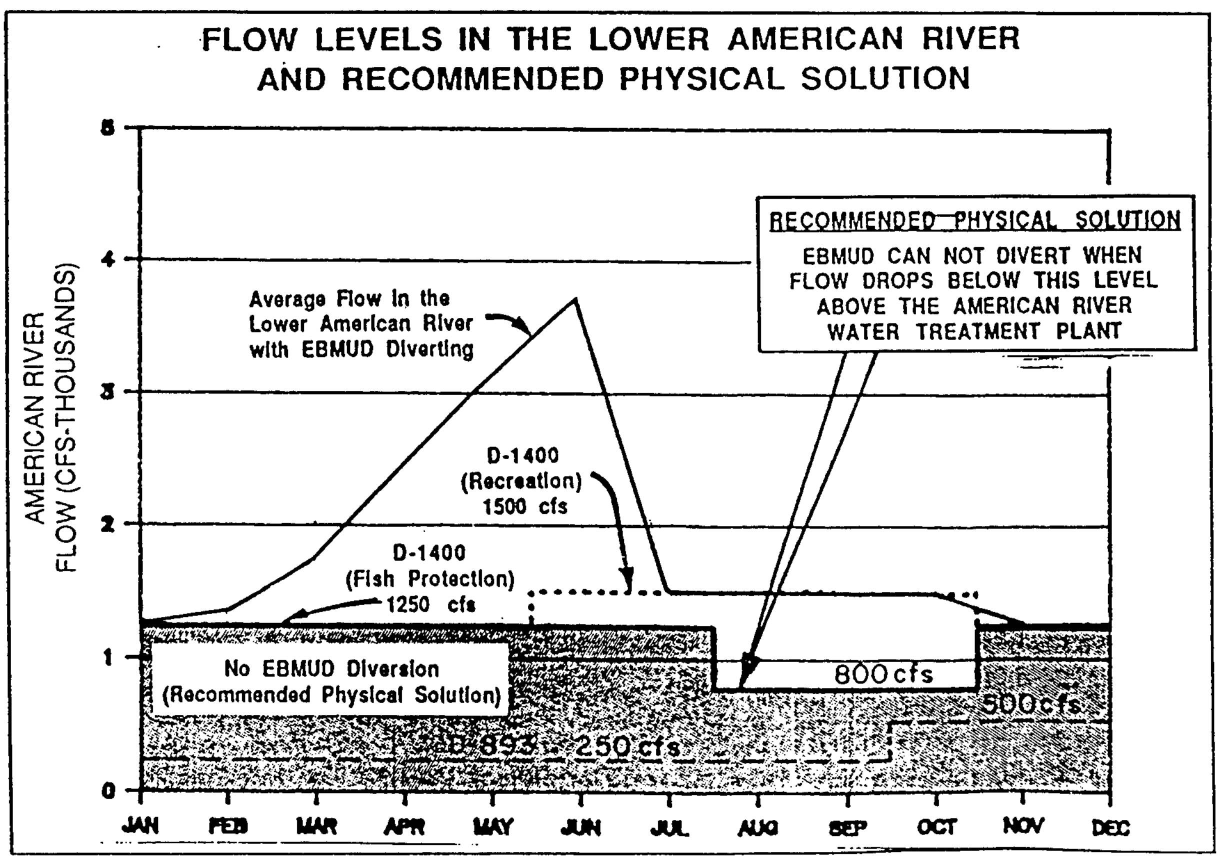


FIGURE 6. Flow Levels in the Lower American River and Recommended Solutions

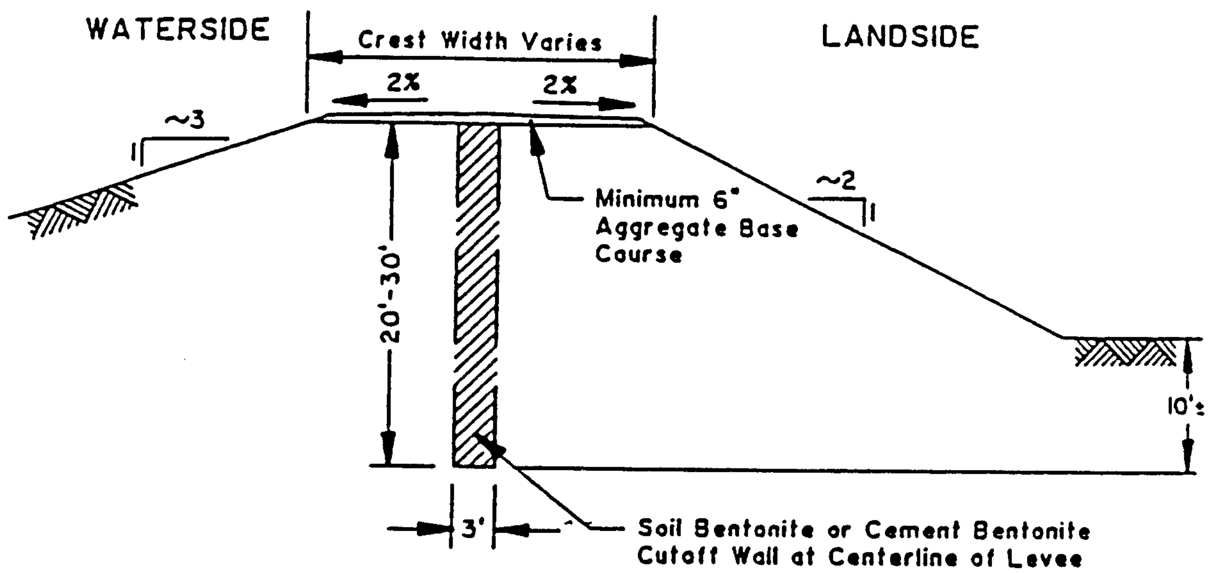
minimum instream flows, this decision does not set any restrictions or minimum instream flow conditions when EBMUD is not diverting. Thus, the inadequate D-893 levels remain as the legally required flow standard to be met by the Bureau of Reclamation and, in fact, flows were dropped to 250 cfs in June 1990 to conserve Folsom storage. The Bureau of Reclamation does, however, operate Folsom Dam using a modified D-893 flow regime, under which flows are ordinarily above those of D-1400 (U.S. Bureau of Reclamation 1989). Note, however, that the Bureau is required only to maintain D-893 flow releases. With build out and exercise of existing contracts, the Bureau estimates that the modified D-893 flow minima will be greatly reduced by the year 2020. Hence, the minimum flows specified in D-893 will occur more frequently (U.S. Bureau of Reclamation 1988).

PROJECT ALTERNATIVES

Two of the action alternatives would involve no modification of the lower American River for flood protection: the 200-Year Protection and the 400-Year Protection alternatives. Three of the alternatives (the 100-Year (FEMA) Levees, 100-Year (FEMA) Levees/Storage, and 150-Year Protection alternatives) would involve modification of the lower American River, as well as modification of the Sacramento Weir and Bypass, to accommodate larger objective flood control releases from Folsom Reservoir than the present objective release of 115,000 cubic feet per second (cfs). In addition, for the 150-Year Protection alternative it would be necessary to raise the height of Yolo Bypass levees from the Sacramento Weir southward. The impacts of the remaining alternative, 100-Year (FEMA) Storage, would be a consequence of increasing the flood control storage space in Folsom Reservoir from 400,000 to 590,000 acre-feet. This alternative would not require modification of the lower American River below Folsom Dam.

Increasing the river's capacity for the safe conveyance of higher flows would be accomplished by the construction at strategic locations of slurry wall, toe drain, raised and new levee, and the application of riprap to banks and levees. These construction features are illustrated in Figures 7 through 11. Some modification of bridges would also be required.

Each of the three alternatives would require lengthening the Sacramento Weir and widening the Sacramento Bypass in increments proportional to the magnitude of the Folsom Reservoir objective release (Figure 12). The linear extent to which Yolo Bypass levees would be raised for the 150-Year Protection alternative is shown in Figure 13. The flood-protection features associated with each of these alternatives are itemized below.



TYPICAL SECTION

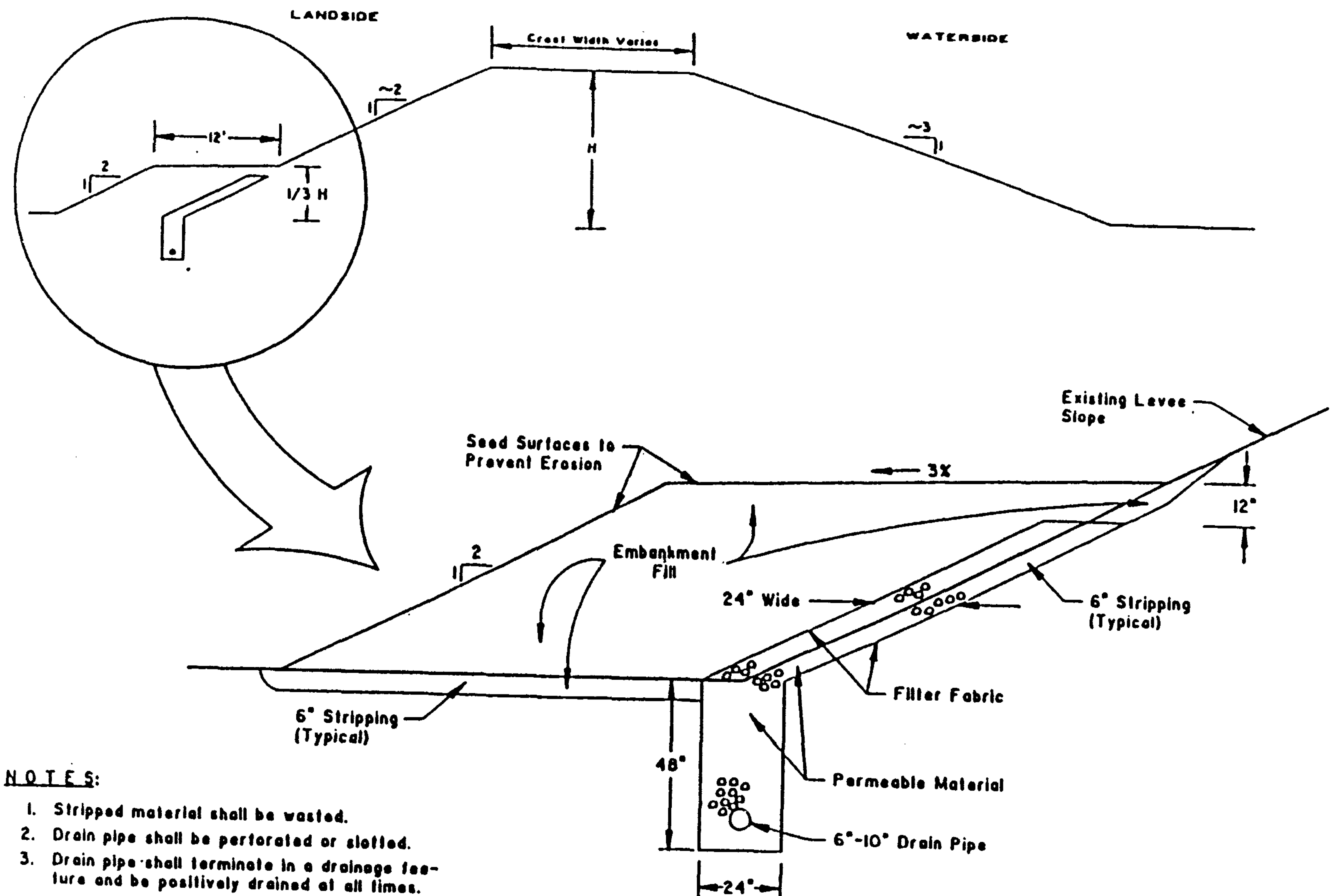
FIGURE 7

CUTOFF WALL

AMERICAN RIVER WATERSHED
FEASIBILITY STUDY

AUGUST 1989

LOWER AMERICAN RIVER ALTERNATIVE

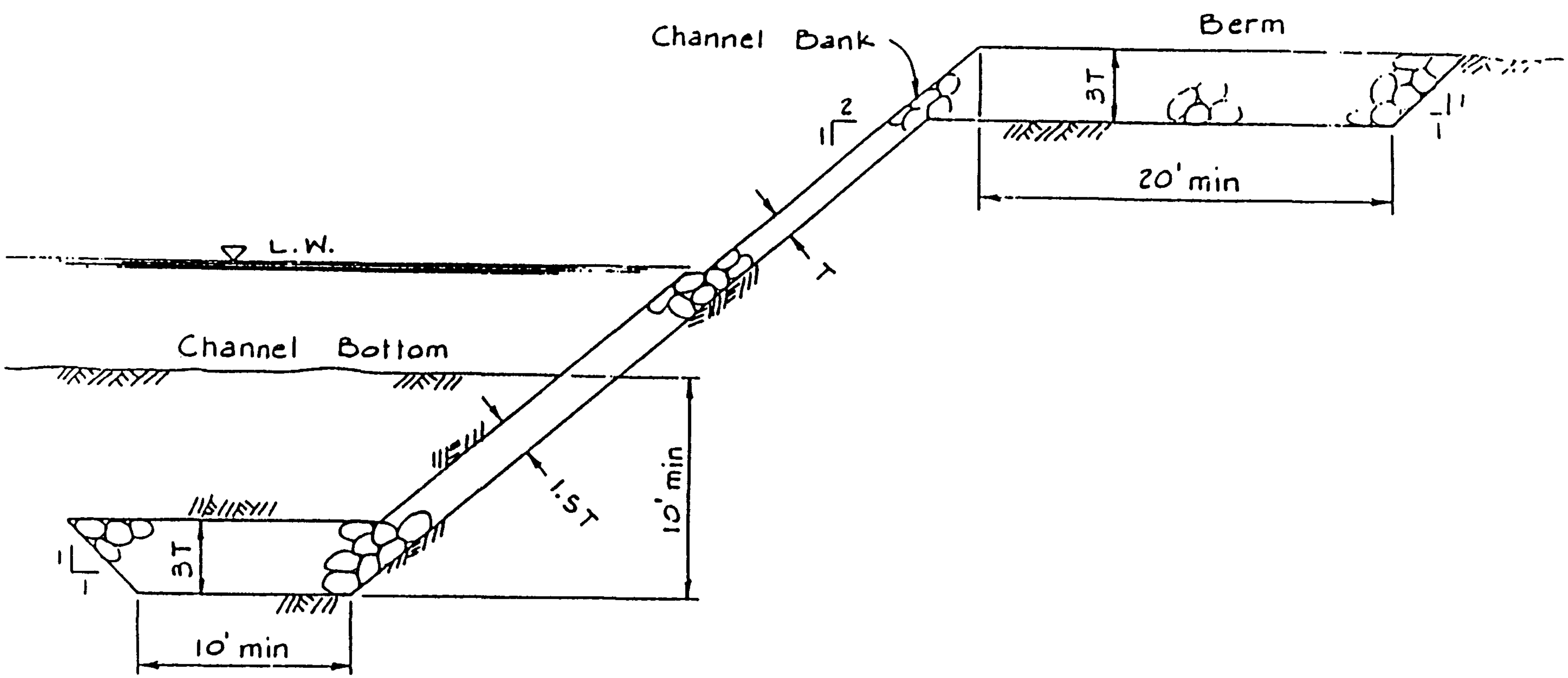


NOTES:

1. Stripped material shall be wasted.
2. Drain pipe shall be perforated or slotted.
3. Drain pipe shall terminate in a drainage feature and be positively drained at all times.
4. Permeable material shall conform to ASTM C 33 gradation 57 or 67.
5. Filter fabric shall be a woven fabric with an AOS of 70 to 120.
6. Filter fabric shall completely surround permeable material.

FIGURE 8

BERM WITH TOE DRAIN
AMERICAN RIVER WATERSHED
FEASIBILITY STUDY
AUGUST 1989
LOWER AMERICAN RIVER ALTERNATIVE



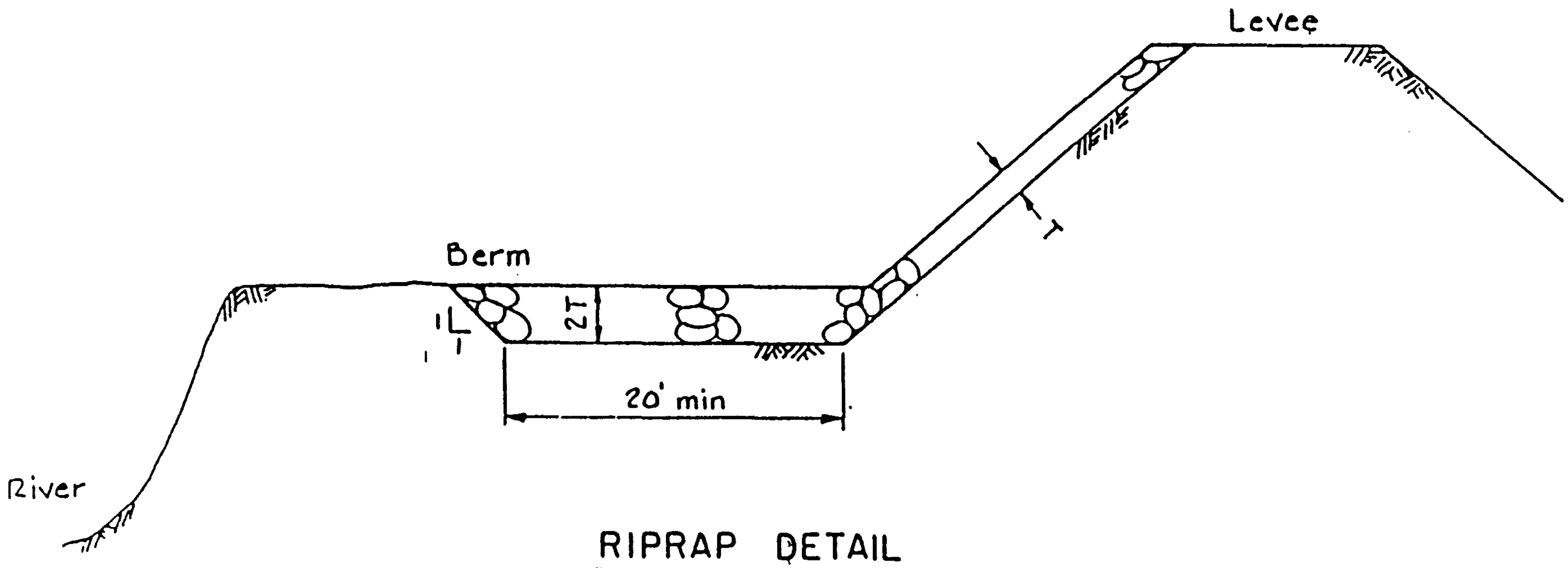
RIPRAP DETAIL

NOT TO SCALE

LOWER AMERICAN RIVER

CHANNEL BANK
ONLY

FIGURE 9



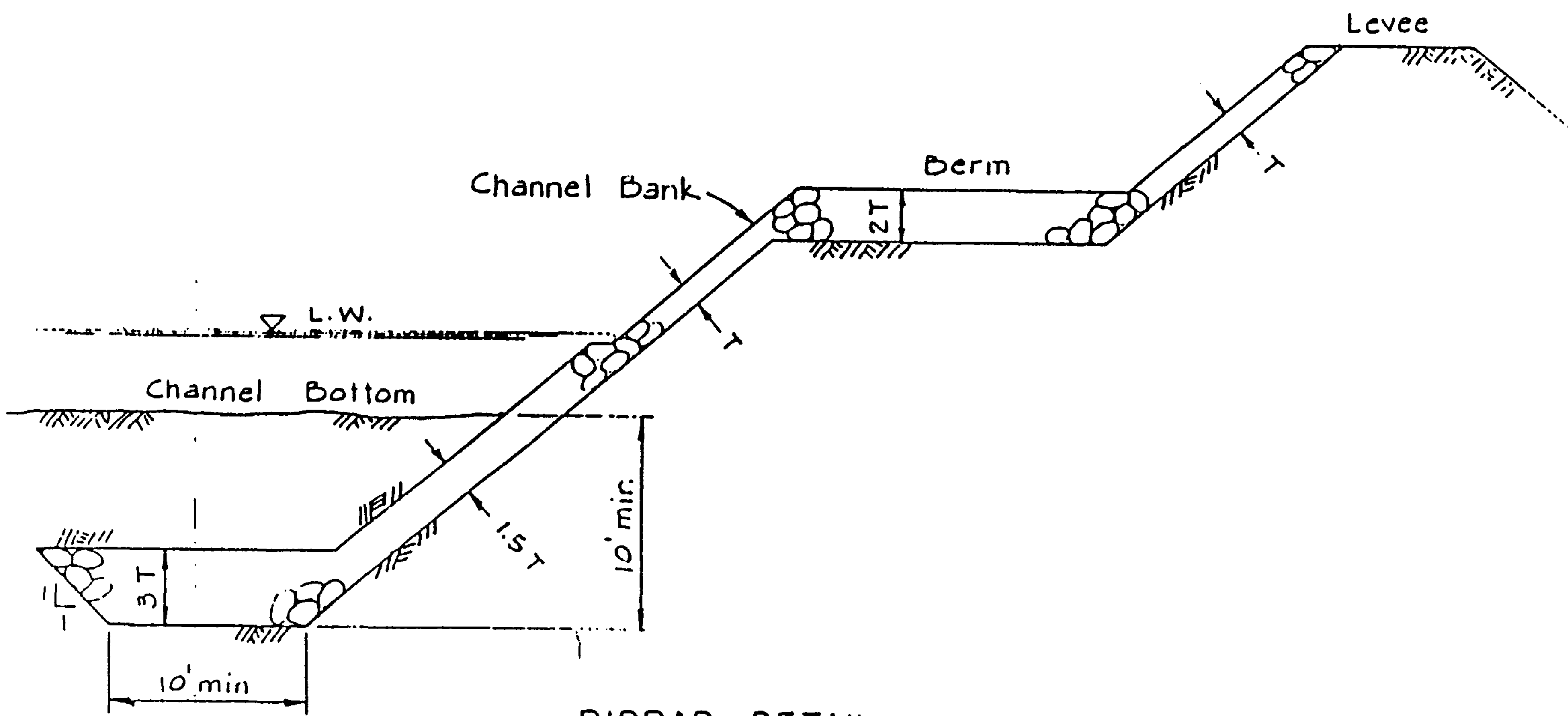
RIPRAP DETAIL

NOT TO SCALE

LOWER AMERICAN RIVER

LEVEE
ONLY

FIGURE 10



RIPRAP DETAIL

NOT TO SCALE

LOWER AMERICAN RIVER

CHANNEL BANK
& LEVEE

FIGURE 11

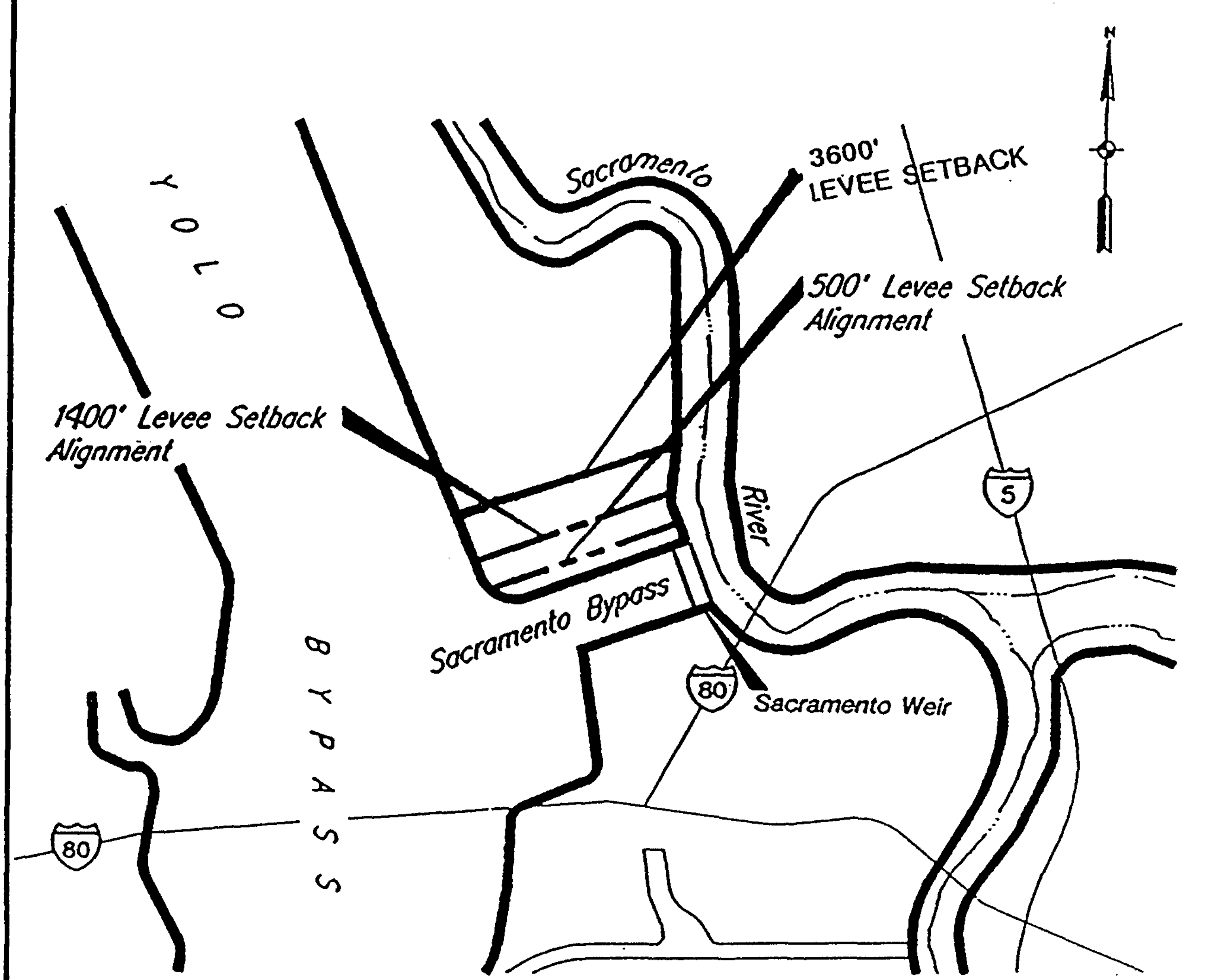


FIGURE 12

MODIFY SACRAMENTO WEIR
AND BYPASS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
JANUARY 1989

NOT TO SCALE

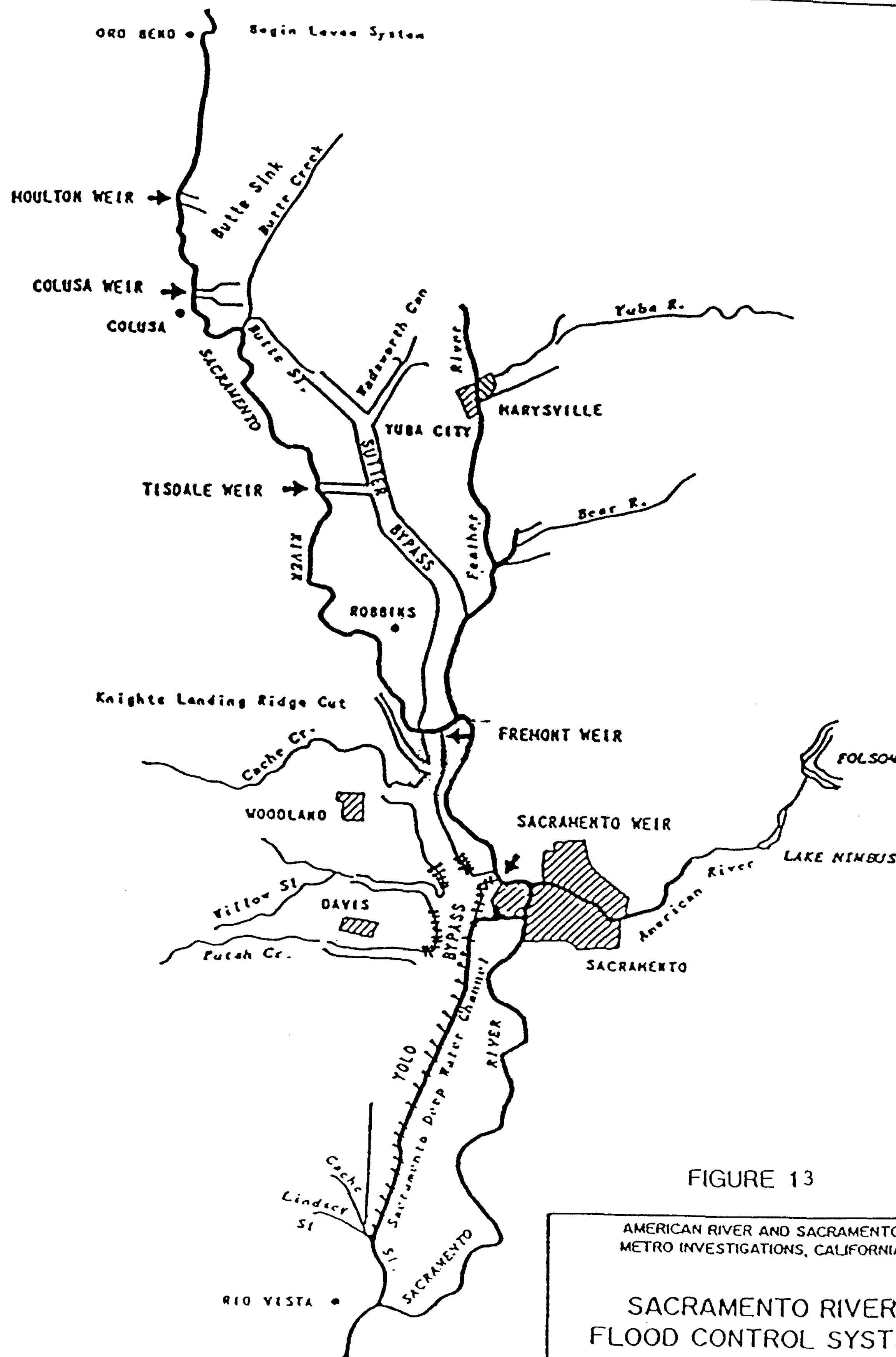


FIGURE 13

AMERICAN RIVER AND SACRAMENTO
METRO INVESTIGATIONS, CALIFORNIA

SACRAMENTO RIVER
FLOOD CONTROL SYSTEM

CORPS OF ENGINEERS. SACRAMENTO. CALIFORNIA

Prepared: J.H.
Drawn: J.H.
Date: JANUARY 1990

100-Year (FEMA) Levees Alternative (145,000 cfs*)

- Construct: 3 miles of slurry wall
  7 miles of toe drain
  1 mile of new levee
  5 miles of raised levee
  1.5 miles of bank riprap
  5.3 miles of levee riprap
  3.2 miles of levee and bank riprap

- Raise north trestle of Union Pacific Railroad bridge
- Raise north end of H Street bridge
- Widen Sacramento Bypass 1,400 feet by realigning 1.8-mile-long north levee to a height of 26 feet
- Lengthen Sacramento Weir 1,400 feet

  * Folsom Reservoir objective release

100-Year (FEMA) Levees/Storage Alternative (130,000 cfs*)

- Construct: 0.7 mile of slurry wall
  0.6 mile of toe drain
  0.9 mile of new levee
  1.5 miles of bank riprap
  5.3 miles of levee riprap
  3.2 miles of levee and bank riprap

- Raise north trestle of Union Pacific Railroad bridge
- Widen Sacramento Bypass 500 feet by realigning 1.8-mile-long north levee to a height of 26 feet
- Lengthen Sacramento Weir 500 feet
- Increase Folsom Reservoir space 70,000 acre-feet
- Lower Folsom Dam spillway 15 feet, install new tainter gates, and lengthen stilling basin

  * Folsom Reservoir objective release

150-Year Protection Alternative (180,000 cfs*)

- Construct: 4.1 miles of slurry wall
  7.8 miles of toe drain
  1.0 mile of new levee
  11.4 miles of raised levee
  1.5 miles of bank riprap
  5.3 miles of levee riprap
  3.2 miles of levee and bank riprap

- Raise north trestle of Union Pacific Railroad bridge
- Raise north side of H Street bridge
- Replace Howe avenue bridge

- Widen Sacramento Bypass 3,600 feet by realigning 1.8-mile-long north levee to a height of 26 feet
- Lengthen Sacramento Weir 3,600 feet
- Raise Yolo Bypass east and west levees from Sacramento Weir southward
- Increase Folsom Reservoir storage space 250,000 acre-feet

    * Folsom Reservoir objective release

Mitigation features provided for in the project plan for each of the alternatives affecting the lower American River include a program to plant woody riparian species and monitor their growth, and a program to rehabilitate salmon spawning gravels. An additional mitigation feature of each alternative, except the 100-Year (FEMA) Levees alternative, is the replacement of habitat in Folsom Reservoir.

EXISTING CONDITIONS

VEGETATION

The Folsom Reservoir - Lake Natoma - lower American River area extends across a natural transition zone from the higher elevation habitats of the lower Sierra foothills to those of the valley floor.

Folsom Reservoir

Behind Folsom Dam the once-dynamic river channel has been replaced by the relatively staid conditions of Folsom Reservoir. The riverine riparian vegetation that existed along the now-inundated river channel has been eliminated. Skeletons of riparian forest trees can be seen in lower portions of the inundation zone during low water periods. The only significant riparian forest left on the main reservoir occurs along Sweetwater Creek on the South Fork arm (California Department of Parks and Recreation 1979).

The perimeter of Folsom Reservoir supports two broad vegetation cover types: live oak woodland and savanna-grassland. The more restricted savanna-grassland occurs primarily at the southern end of the reservoir, while live oak woodland, with tree canopy frequently exceeding 30 percent coverage, occupies the upslope areas surrounding most of the reservoir. Although grassland species comprise the dominant ground cover in both cover types, the live oak woodland includes a substantial mid-story shrub layer.

Most of the annual grasses (50-90 %) are naturalized European species (California Department of Parks and Recreation 1979). Common grasses include wild oats and slender wild oats, softchess, foxtail, red brome, dog tail grass, and many other less common species. The more notable native grasses include purple needle grass, elymus, and several fescue species. Wild flowers, both native and alien, which contribute an important visual and asthetic aspect to the grasslands, include California buttercup, golden poppy, bush and annual monkey flowers, lupines, popcorn flower, clovers, California goldenrod, mustard, fiddleneck and many others.

The savanna-grassland cover type consists of an essentially two-layered community, with a grass-dominated ground layer and highly dispersed tree canopy layer. The tree canopy typically begins about 6 to 10 feet above the ground and extends to about 40 to 80 feet, rarely reaching as high as 100 feet. The tree canopy in the savanna-grassland typically covers less than 30 percent of the ground and in some cases less than 10 percent. Savanna trees typically consist of blue and valley oaks, although digger pine and interior live oak may also be present and sometimes dominate. The most obvious feature of the savanna-grassland community is the virtual absence of a shrub layer.

Live oak woodland typically consists of a multi-layered (mainly three stratum) plant community, dominated by broadleaf evergreen and deciduous trees (mainly oaks), with some scattered needle-leaf evergreen digger pines. Interior live oak and/or canyon live oak typically dominate, but some blue oak, black oak, madrone, digger pine, and California laurel may be present. Valley oak and coast live oak rarely occur in the dense foothill woodland plant community around Folsom Reservoir. In some locations, the woodland trees form nearly closed canopies with crown cover up to 90 percent (California Department of Parks and Recreation 1979).

The most dramatic land feature of Folsom Reservoir, especially during the summer period, is the drawdown zone around the margin of the reservoir. This essentially barren-soil zone exists as a consequence of the managed water fluctuations of the reservoir, which frequently lower the water level more than 60 feet during the course of the spring and summer. In many years, the entire 72 mile shoreline of the reservoir consists of barren, decomposed-granite soil virtually devoid of vegetation. The zone is essentially incapable of sustaining vegetation, especially woody species, because of the erratic inundation/dewatering cycles dictated almost exclusively by existing water and power contracts.

Lake Natoma

The vegetation flanking Lake Natoma has retained most of the riparian forest characteristics and species that occurred before dam construction, except the band of vegetation is much narrower than that seen along the lower American River. This is a consequence of the more consistent water level behind the dam.

However, on upland sites, well above the water edge, evergreen hardwood species such as canyon live oak and interior live oak assume clear dominance over the deciduous hardwoods of lower elevations. Also, digger pine, a distinctive evergreen conifer of the foothill zone, shows increased importance in the vegetation. Understory vegetation, which consists of typically two layers, is dominated at ground level by herbaceous grassland species. Woody foothill shrubs such as yerba santa, redbud, coffeeberry, buckbrush, coyote bush, buckeye, and a few white leaf manzanita typically comprise the often impenetrable shrub layer.

Lower American River

The vegetation within the American River corridor gradually changes across the transition of low foothills to valley floor. At the upper end, below Nimbus Dam, typical valley floor riparian habitats are restricted to a narrow band immediately along the river edge. The topographically more variable uplands support mainly evergreen hardwood forests dominated heavily by foothill live oaks, and a few scattered occurrences of foothill grassland. At the lower end of the river corridor, near the confluence with the Sacramento River, the generally flat topography supports a typical valley floor habitat-complex of grassland, emergent freshwater marsh, riparian scrub-shrub, and deciduous hardwood forest.

Forest and woodland dominants on the valley floor include a diverse mix of exclusively deciduous trees including cottonwoods, willows, valley oak, alder, boxelder, Oregon ash, and a few sycamore. As one moves away from the river toward the uplands, the riparian forest typically gives way to woodland and grassland habitats and areas of frequent disturbance. At the topographically and geographically more variable upper end approaching Nimbus Dam, evergreen hardwoods, mainly canyon and interior live oaks, begin to dominate the upland sites especially on steep slopes. Digger pines, the lowest elevation evergreen needle-leaved tree, begin to show increasing presence in the vegetation. The deciduous hardwood riparian species of the valley floor become more narrowly restricted to the immediate river edge.

As a consequence, the lower American River supports a rich and diverse mosaic of vegetation. The structure, composition and successional stage of the vegetation of the lower American River, is directly related to channel dynamics, topography, elevation, distance from the river and frequency of inundation (Watson 1985, Strahan 1984). Controlled flows from Folsom Dam and the resulting decrease in high intensity winter and spring flows and an increase in summer flows, have resulted in increased bank and channel stability (Watson 1985). The decreased river dynamism, meander potential, and increased channel stability changed many of the riverine processes important to maintaining the natural diversity of the riparian vegetation. For example, rates of new gravel bar formation and sediment recruitment, inflow and deposition have been greatly reduced with the damming of the river at Folsom. These process changes have greatly affected the structure and regeneration of the riparian forest vegetation. Two of the most noticeable changes have been the shift toward an increased age structure of the cottonwood forest and increased abundance of white alders.

In the absence of the above river processes of new gravel and sand bar formation, and in combination with increased summer flows, cottonwood recruitment has been virtually eliminated and existing stands appear to be aging without opportunities for replacement. On the river edge, alders have increased in abundance by taking advantage of the more consistent summer flows and increased bank stability (Dr. Robert Holland, pers. comm. 1989).

The vegetation of the upper 11 miles of the lower American River occupies a broad expanse within the floodway unconfined by man-made levees and restricted only by the natural topography and, in some areas, the American River Parkway boundary. Vegetation in the lower 12 miles is confined within the boundaries of the man-made levees and, in most areas, limited to a narrow band between closely built levees and the river itself.

Vegetation of the lower American River has been described by Sanders (1985), Watson (1985), and the U.S. Bureau of Reclamation (1988). Most of these reports classified the vegetation into many narrowly defined units, attempting to accurately represent the great diversity and complexity of this riparian plant community. We have, however, categorized the vegetation into more broadly inclusive wildlife habitat cover types, which in some instances correspond with accepted vegetation community titles including: the open water aquatic habitat, freshwater marsh, riparian scrub-shrub, riparian forest (which includes two subcategories: young willow-cottonwood forest and mixed riparian forest), oak woodland (valley and evergreen hardwood) and grassland. The acreages of each cover type are shown in Table 1.

The <u>open water</u> aquatic zone includes the main river channel and also slow moving backwaters and ponded waters, created primarily

from the past natural meandering of the river and historical gravel quarrying and gold dredging that occurred along most of the American River Parkway (Figure 14). Floating and submerged aquatic vegetation dominate in the shallow slow-moving backwaters and ponds. Plant species typical of this habitat include water fern, pondweed, water milfoil, yellow water weed, elodea, duckweed, water primrose and water lily. About 126 acres of open water area exist outside the main river channel (1988 aerial photos).

Table 1. Acreage of Habitat Cover Types Along the Lower American River Floodway from Nimbus Dam to the Sacramento River Confluence.

Habitat Cover Type	Gross Acreage
Open water aquatic (does not include main river channel)	126
Freshwater marsh	34
Riparian scrub-shrub	2,272
Riparian forest	1,258
Oak woodlands	109
Grassland	430
Grain	170
Pasture	236

Note: Acreage based on FWS habitat maps, 1989.

Associated with open water aquatic areas are <u>freshwater marshes</u>. An estimated 34 acres of marsh habitat exist along the floodway (Table 1). Marsh vegetation is typically intolerant to seasonal aridity, wide fluctuations in water level, and fast-moving water. Marshes, which usually develop in water depths of less than 5 feet, are characterized by emergent vegetation including dense growths of tules and cattails and lesser amounts of smartweed and various rush and sedge species (Figure 15). The Sanford's sagittaria, a rare species and candidate for Federal listing as an endangered or threatened species, occurs in several of the marshes within the lower American River.

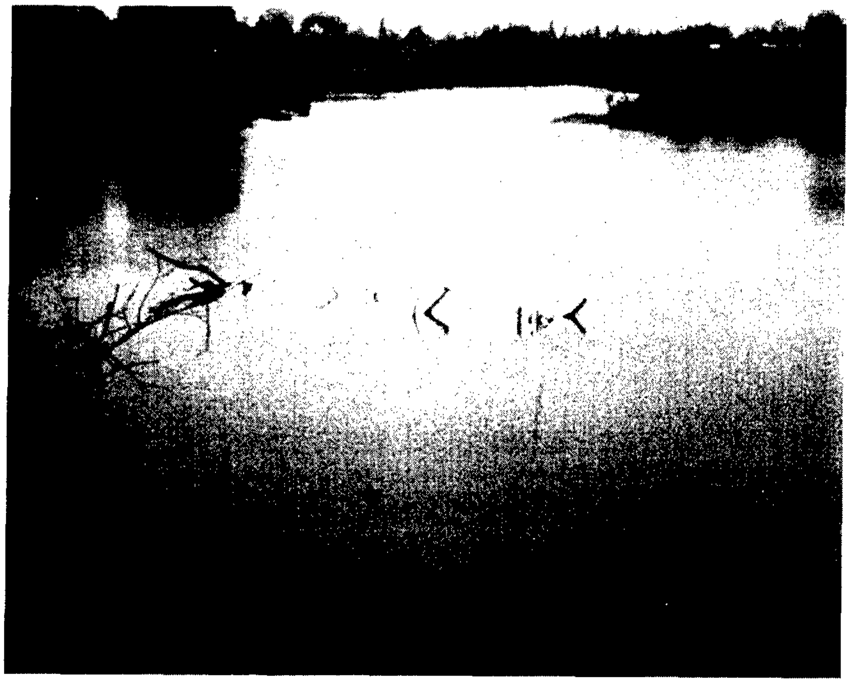


FIGURE 14. OPEN WATER

FIGURE 15. FRESHWATER MARSH

The <u>riparian scrub-shrub</u> community occupies about 2,272 acres in the active channel portions of the river and other areas that are subject to repeated inundation (Figure 16). This cover type also frequently occurs along the border of backwater areas off the main river channel, which, like the active channel, is controlled by the intensity and duration of annual high and low flows. Increases in the white alder and shrub willow components of this cover type likely have occurred with increased bank stability, decreased bank erosion, and greater availability of summer flows along the active zone (Sanders et al. 1985). Typical scrub-shrub habitat generally lacks tall tree cover and is dominated by thickets of woody shrubs such as willows, young cottonwoods, white alder, coyote bush, button bush, and various herbaceous species. Herbaceous species found within scrub-shrub habitats include goldenrod, horseweed, mustard, thistles and vervain. The shrub layer may also include thickets of blackberry, rose, wild grape, elderberry and some seedling and sapling oak, walnut, cottonwood, tree willows and Oregon ash, depending upon the location within the various flood frequency zones of the floodway. In some locations, especially on sandy uplands, elderberry becomes abundant and dense.

In frequently disturbed sites, such as the most frequently scoured and flooded areas of the active zone, maturation of the scrub-shrub vegetation to forest may be extensively protracted or prevented. This situation is most prevalent in the upper reach of the river where erosion-resistent gravel beds provide the main substrate for establishment of early successional vegetation, but flows out of the reservoir retain great erosive energy.

The <u>riparian forest</u> cover type, which occupies an estimated 1,258 acres within the lower American River floodway, includes two subcategories: young willow-cottonwood forest and mixed riparian forest. These two vegetation sub-types are best developed in the border zone and the transition to the outer zone (Sanders et al. 1985). Regeneration and maintenance of high diversity within this cover type is dependent upon periodic and low intensity flooding and periodic sediment deposition. Moist banks with freshly deposited sediments typically provide regeneration sites for young growth willow-cottonwood forests (Figure 17). Young stands of this early "successional" community typically provide a canopy 10-40 feet tall.

Common dominants in the more mature stands of this cover type include cottonwood, box elder, black willow, arroyo willow, red willow, and Oregon ash. Wild grape and other herb-vine species often form a dense, draping understory. In many areas along the active zone and the lower portions of the border zone, there is increasing coverage by white alder thickets apparently as a consequence of the more stable channel conditions, reduced sediment deposition and reduced erosion, especially in the upper subreach of the river (R. Holland, California Nat. Diversity Data

FIGURE 16. RIPARIAN SCRUB-SHRUB

FIGURE 17. RIPARIAN FOREST-YOUNG COTTONWOOD/WILLOW

Base, pers. comm. 1989). In contrast, cottonwood seedling regeneration appears virtually nonexistent in all portions of the main river channel.

Mixed riparian forests, located in the border zone and along the transition to the outer zone, typically occur above the areas experiencing frequent flooding and deposition. At the higher portions of the border zone, and transition to the outer zone, forests typically consist of the more mature and diverse tall-forest communities (Figure 18) which eventually give way to savanna and grassland habitats in the highest, least-frequently flooded terraces.

The younger, higher elevation forests, found mainly in the middle and lower portions of the river, frequently support lush multi-layered tree canopies up to 150 feet tall comprised of cottonwood, sycamore, Oregon ash, valley oak, and walnut.

The mid-story layer may include young trees of the canopy species, along with the shorter black willow, boxelder, and various shrub species. The shrub understory often includes very dense thickets of wild grape vines, blackberry vines, poison oak (vine and shrub), and clematis vines. These vines often drape over the upper- and mid-story trees giving a jungle-like appearance to the vegetation. Elderberry and wildrose shrubs are also frequently present. The herbaceous layer is typically thick, composed of grasses and forbs.

The valley oak woodland is best developed in the outer zone, in areas where the forest vegetation has matured past the riparian forest condition. These areas receive flood waters much less frequently than the lower zones, although the woody vegetation is clearly dependent upon subsurface water from the adjoining stream environment (Sanders et al. 1985). The typically open overstory is dominated by valley oak with an occasional black walnut and old cottonwood (Figure 19).

The canopy of valley oak woodland varies from sparse to dense, typically greater than 30 percent. The sparse shrub layer is often comprised of blackberry, poison oak, elderberry, and a few tree saplings of various species. The ground cover, characteristically dominated by herbaceous ruderal grasses and forbs, may exhibit substantial shifts in species composition depending upon the yearly weather patterns and/or inundation frequency and durations.

Valley oak woodlands are of great ecological importance because of their relative scarcity and high wildlife values. The location of valley oak woodland in areas of deep fertile soils and infrequent flooding has contributed to their rarity because these areas are highly desirable for agriculture and urban development and yet lie close to the river. Urban development,

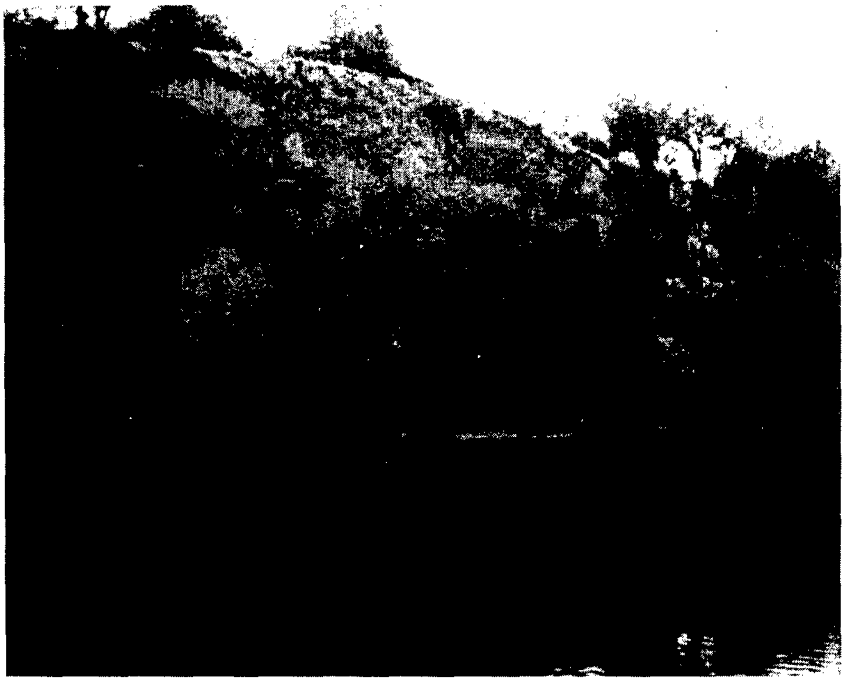


FIGURE 18. RIPARIAN FOREST MIXED

FIGURE 19. VALLEY OAK-WOODLAND

which now surrounds the existing levees and floodways, eliminated the former outer zone oak woodlands-grasslands and border zone mixed riparian forest habitats of the historical natural floodplain. Thus, the continued existence of the full array of upper terrace and outer zone habitats within the levee system depends upon a flow regime modulated within the existing floodway capacity.

With an increase in elevation from the valley floor to the base of the Sierra foothills, there is a shift in the composition of the woody species in this outer zone and upper terrace habitats. The valley oak typically dominates in the deeper alluvial soils of the lowland areas but gradually yields dominance to interior and canyon live oaks as elevations increase and soils change into the foothill areas.

The evergreen hardwood woodland is a live oak-dominated habitat occurring on drier uplands in the upper portions of the lower American River, being largely associated with the localized occurrences of the Fair Oaks or Victor volcanic formations (Holland pers. comm. 1985). Although variable in canopy cover, along the lower American River it most frequently has a distinctly woodland character with an open to moderately open canopy (30-50 % closure). In some areas, canopy density reaches complete closure such as in the Sacramento Bar area and Sunrise Park.

Interior live oak is the consistent dominant of this cover type along the lower American River with lesser contribution from canyon live oak. Occurrences of this cover type can be found as far downstream as Goethe Park. At higher elevations, into the foothills, the canopy dominance shifts to canyon live oak. Understory structure varies to a great extent, including sites with essentially grassland understory (two-layered), to those with moderate densities of understory shrubs (three-layered). Foothill species such as digger pine, buckeye, and deer brush also occur in this cover type usually at localized sites in the higher elevations of the upper floodway. About 109 acres of combined valley oak and evergreen hardwood exist in the floodway.

Well-developed grassland communities normally would occur outside the flood zone in areas that are now urbanized. Thus, grasslands that now exist within the floodway are usually associated with sites of recent human disturbance (Figure 20), such as levee slopes, former agricultural fields, and waste fields (Susan Sanders et al. 1985), and areas subject to periodic burning, frequent inundation, or scouring.

The American River floodway now supports about 430 acres of grassland habitat of varying qualities. Included in this cover type are waste fields, dredge tailings dominated by grasses and herbaceous cover, and fallow agricultural fields. Common

FIGURE 20. GRASSLAND

dominant species include mainly non-native grasses and forbs, such as star thistle, brome, oat, fescue, filaree, and barley grasses. Native species of popcorn flower, clover, lupine, poppy, and fiddleneck are sometimes sparingly intermixed.

Although relatively few acres of actively farmed lands remain in the floodway, those areas remaining provide wildlife habitat. About 170 acres of grain field and 236 acres of pasture exist above the south bank of the river.

FISH

Folsom Reservoir

Mean and maximum Folsom Reservoir depths are, respectively, 66 and 266 feet. A thermocline develops in the reservoir each year with adequate oxygen for fish in the hypolimnion. No chronic water quality problems have been identified. Average total dissolved solids and total phosphorus levels in the period 1970-1979 of 46 milligrams per liter and 0.02 milligrams per liter indicate low nutrient levels. This contributes to Folsom's lower productivity as compared to many other Central Valley reservoirs. Annual reservoir level fluctuations of 60 feet or more also reduce natural productivity and thus adversely affect fish populations.

Folsom Reservoir supports both a coldwater and warmwater fishery. Previously planted land-locked populations of salmon and continual hatchery plantings of rainbow trout make up the coldwater fishery. Important warmwater gamefish include largemouth and smallmouth bass, white catfish, brown bullhead, channel catfish, and several sunfishes. Many other resident non-game fishes are also present (Appendix A). Prior to Folsom Dam construction, the California Department of Fish and Game recommended that brush and rock cover be retained and supplemented for fish habitat. In addition, Fish and Game recommended that a 100 surface acre sub-impoundment be constructed for applied fisheries management. The sub-impoundment was not constructed, and it appears that all brush and trees were removed from the fluctuation zone. Follow-up habitat rehabilitation programs including installation of artificial kelp plantings for warmwater fish cover and willow plantings in the shoreline fluctuations zone have failed to improve fish habitat conditions.

The present warmwater fishery is supported by largemouth bass, smallmouth bass, sunfish, and catfish (primarily white catfish and channel catfish). Florida bluegill were introduced in 1982 because they grow to a larger size than the northern strain of bluegill. It is hoped that they will enhance shore angling. Both Florida and Alabama spotted largemouth bass have been introduced in an attempt to bolster the bass fishery and a 12-

inch size limit is now in effect. However, no marked improvement in the fishery has been noted.

The existing coldwater fishery is maintained by fish planted by California Department Fish and Game. Natural reproduction does occur in streams leading to the lake but is limited by instream factors (barriers, fluctuating flows). The present management program consists of planting about 70,000 one-half pound, catchable-size rainbow trout and about 5,000 chinook salmon when they are available. Since the introduction of threadfin shad, management emphasis has shifted away from kokanee to a put-and-grow rainbow trout system where subcatchable to catchable trout are planted in the spring. They grow during the summer in the cool deep water and provide large-size fish to the angler the following winter and spring.

The current warm and cold water fishery at Folsom Lake (Figure 21) is estimated at 120,000 angler-days annually (Fish and Wildlife Service 1984).

Lake Natoma

Lake Natoma was constructed as a re-regulating afterbay for Folsom Reservoir; thus it fluctuates daily and weekly from four to seven feet. During most of the year, Lake Natoma receives controlled releases from Folsom Reservoir. The shutter system at Folsom Dam permits some flexibility in management of water temperature of releases for fishery purposes. Therefore, cool water releases for fish are generally being made from December through June when possible. Due to its small size and rapid turnover, Lake Natoma has little effect on water flowing through it. Water temperatures of Nimbus releases are nearly the same as Folsom releases.

The cold temperatures and rapid turnover limit primary productivity. With combined daily water level fluctuations, limited food production, and cold water temperatures, Lake Natoma is not suitable for natural warmwater or coldwater fish production. To compensate for these deficiencies, the Fish and Game Department for several years maintained a catchable trout planting program on a "put and take basis" (Gerstung 1971). This program was discontinued and is now limited to an annual plant in June of 1,000 one-half pound catchables on a "free fish day." Lake Natoma supports many of the same species found in Folsom Reservoir but at much reduced levels. Some recruitment of warmwater and coldwater fishes likely comes from Folsom Reservoir.

With annual planting of catchable trout, the angler-use at Lake Natoma is estimated at 150,000 days (Fish and Wildlife 1984).

FIGURE 21. ANGLERS ON FOLSOM LAKE

FIGURE 22. ANGLERS ON LOWER AMERICAN RIVER

Lower American River

The American River (Figure 22), including backwaters and dredger ponds, downstream from Nimbus Dam to the Sacramento River confluence supports at least 41 fish species, about half of which are game fish. Common game species include chinook salmon, steelhead trout, American shad, striped bass, and resident species including rainbow trout, smallmouth and largemouth bass, bluegill, and catfishes. Nongame species include carp, Sacramento squawfish, Sacramento suckers, hardhead, and other species. Prior to construction of Folsom and Nimbus Dams, salmon and steelhead were found in the river above the damsites. Construction of the dams, however, blocked access and innundated much of the spawning habitat upstream of the dams. Now these species are found only below Nimbus Dam. The chinook salmon population just prior to construction of Folsom Dam was estimated at 26,500 spawners. Before the gold rush and early water and power developments, the American River supported far more salmon. Today, however, salmon numbers have increased significantly over preproject estimates. An average of 47,500 adults enter the American River to spawn annually.

Habitat for anadromous species (salmon, steelhead, American shad and striped bass) is exceptional. Although only 23 miles in length, the river provides a large quantity of excellent quality habitat for these species. The numbers of fish presently found in the lower American River attest to its quality. However, water temperatures at times can reach marginal to lethal levels for juvenile salmon and steelhead during spring and summer, particularly in the lower reaches of the river. Chinook salmon that have not reached a size of about 75 mm and successfully out-migrated by late spring are forced to over-summer in the river because of unacceptable conditions for migration in the estuary. Because of high water temperatures in the lower river, these juveniles concentrate in the reach immediately below Nimbus Dam where they suffer from competition for food and cover and predation. These fish do not survive the summer in appreciable numbers. For the same reasons, natural steelhead production in the lower river is negligible because steelhead remain in freshwater for a full year or more before migrating to sea. The existing steelhead population is maintained by hatchery production. In addition, adult salmon are often faced with lethal or unsuitable water temperatures during the fall spawning season. In recent years, egg production losses of 50 percent and greater have occurred in natural and hatchery production.

The Nimbus Salmon and Steelhead Hatchery, located downstream of Nimbus Dam, is operated by the California Department of Fish and Game under contract with the Federal Government. The existing hatchery was built by the Federal Government in the 1950's as a compensation feature of the Folsom Dam project. The hatchery was planned initially to incubate 30,000,000 chinook salmon and

steelhead trout eggs and to rear the fry to a size suitable for release in the American River. However, subsequent management decisions changed the operation, and the current program is to raise fewer but larger fish -- 3,000,000 smolt-size fall-run chinook salmon (60 fish/lb) and 300,000 yearling (10 fish/lb) steelhead for release in the estuary. Under current management practices, the egg take is much less than that originally planned. Also, since all plantings have been in the estuary, generally below the Sacramento-San Joaquin Delta, hatchery-produced fish are not dependent on the lower American River habitat until they ascend the river to spawn as adults. The hatchery produces about 19,000 of the 47,500 spawners (average annual) that return to the American River. Of the 19,000, an average of about 10,500 are taken into the hatchery for artificial spawning. The remaining 8,400 hatchery-produced salmon spawn in the lower river. The hatchery-and river-produced fish probably return to the hatchery and river to spawn indiscriminantly.

The fall-run chinook salmon is considered to be the most important species in the American River because of its value to the commercial and sport fishery. For the twelve-year period from 1969 to 1981, adult chinook salmon returning to the American River and Nimbus Hatchery to spawn averaged 47,500 fish, with a high of 95,000 fish in 1973 (Table 2). Approximately 19,000 (40 percent) and 28,500 (60 percent) are the result of hatchery and river spawning, respectively, assuming there is no net loss or gain in numbers due to straying between the American River and other rivers such as the Sacramento and Feather Rivers. Natural spawning in the river occurs from Nimbus Hatchery downstream to the vicinity of Watt Avenue; however, about 75 percent of the spawning takes place upstream of Ancil Hoffman Park. Spawning activity generally peaks in November, and downstream migration of young occurs from February through June.

The lower American River chinook salmon resource supports significant ocean sport and commercial fisheries. Freshwater angling for salmon, although popular, accounts for only 8 percent of the total harvest. On an annual basis, the lower American River and the hatchery produce an average of 197,600 adult salmon of harvestable size to the fishery -- about one-sixth of the California's total harvest. Of these 197,600, about 150,100 are caught in the ocean commercial (60 percent), ocean sport (32 percent) and river sport (8 percent) fisheries (Table 3). The progeny of 47,500 spawning adult chinook salmon supports: (1) an estimated annual commercial catch of 991,100 pounds valued at $2,775,000; (2) an ocean sport fishery estimated at 60,600 angler-days; and (3) a freshwater sport fishery of 100,000 angler-days. Each angler-day is valued at $124 and $87 for ocean and freshwater fishing, respectively.

TABLE 2. — Chinook Salmon Escapement to the Lower American River and the Nimbus Salmon and Steelhead Hatchery. (1969-1982)[1/]

Year	River Escapement	Hatchery Escapement	Total Escapement
1969-1970	38,800	8,200	47,000
1970-1971	25,200	11,800	37,000
1971-1972	41,900	10,100	52,000
1972-1973	15,700	9,300	25,000
1973-1974	81,900	13,000	95,000
1974-1975	52,900	9,100	62,000
1975-1976	31,600	8,400	40,000
1976-1977	22,500	5,500	28,000
1977-1978	41,100	6,900	48,000
1978-1979	12,800	8,200	21,000
1979-1980	37,800	10,200	48,000
1980-1981	34,300	15,700	50,000
1981-1982	43,500	20,600	64,000
Average	36,900	10,600	47,500

[1/] Figures from various CDFG reports, rounded to nearest 100 or 1000

TABLE 3. – Chinook Salmon Harvest and Escapement to the Lower American River Under Existing Conditions[1/]

Harvest (catch)	150,100
Escapement (spawners)	47,500
Production (Harvest & Escapement)[2/]	197,600
Harvest[3/]	
Ocean commercial catch	90,100
Ocean sport catch	48,000
River sport catch	12,000
Total	150,100

[1/] Number of adults resulting from natural and hatchery spawning.

[2/] Assumes a catch to escapement ratio of 3.16:1.

[3/] Assumes 60% commerical catch, 32% ocean sport catch, and 8% river sport catch.

A significant steelhead trout sport fishery, supported almost entirely by hatchery production, exists in the lower American River. The peak run of adults enters the river from mid-December through January during most years. Eggs are generally taken at the hatchery from January through March. The existing steelhead trout fishery of 27,700 angler-days is supported by an annual spawning escapement of about 20,000 adults. Also, as indicated in our 1984 supplemental detailed report (FWS 1984), a significant fishery exists for American shad, striped bass, and warmwater fish supporting 75,000, 8,000 and 3,000 angler-days, respectively. Each angler-day is valued at $87.

Chinook salmon are anadromous, spending most of their lives in the ocean but returning to spawn in freshwater. Optimal spawning habitat is characterized by silt-free gravel substrates, cool temperatures (43.5-56°F) and swift flow (1-3 feet per second). Eggs are laid in nests, or redds, dug into the gravel. After about two months, the eggs hatch into alevins, which remain in the substrate for several weeks. The total period of intra-gravel residence is highly dependent upon temperature. Fish emerge from the gravel as fry and begin their rearing and emigration phases. The lower American River supports only fall-run chinook salmon.

Chinook salmon begin entering the American River between August and October and continue through January (Gerstung 1971, Leidy and Li 1987). The spawning population is dominated by 3-year-old fish, with varying proportions of 2- and 4-year-olds (Dettman and Kelley 1986). American River chinook salmon average 6,000 eggs per female (Ducey pers. comm.).

Spawning usually begins in October and ends by January (Gerstung 1971). Peak spawning occurs in late November and early December. River geomorphology determines spawning habitat availability. In general, chinook salmon spawn in depositional habitats of gravel-bedded streams rather than in areas of active downcutting. Nearly all chinook salmon spawn in the upper 6.6 miles of the lower American River, although apparently suitable spawning areas occur for about 14 miles below Nimbus Dam.

Egg incubation and survival rates are critically dependent on water temperature. Eggs develop into alevins in 5-11 weeks, and the alevins remain in the gravel several more weeks until most of their egg yolk is absorbed. Healey (1977) reported egg mortalities of 80 percent at water temperature of 61 °F and 100 percent at 63 °F for Sacramento River chinook salmon. Poor survival occurs at water temperatures above 57.0°F. Lower American River water temperatures often exceed this level during the early part of the spawning period.

Important juvenile chinook salmon microhabitat components include water velocity, depth, substrate, and cover (Beauchamp et al.

1983). Juveniles are generally associated with velocities and depths in proportion to body size (Chapman and Bjornn 1969); very young chinook prefer low velocities and shallow depths and then shift to faster, deeper water as they grow.

Many salmon fry migrate out of the lower American River immediately upon emergence from their redds in late winter and early spring, usually before late March or mid-April (Gerstung, 1971; Kelly et al., 1985a and 1985b). Many fry rear in the river before emigrating in April, May, and June. American River fry prey items include chironomids, copepods, cladocerans, caddisfly pupae, mayfly nymphs, and many other invertebrates (U.S. Fish and Wildlife Service 1983).

Discharge rates (i.e., increasing, decreasing, and pulse flows) are thought to exert a major influence on emigration rates of emergent fry, fingerlings, and pre-smolts. Juvenile chinook salmon that do not emigrate by late June may suffer high or possibly total mortality from high water temperatures in the lower American River (Leidy et al. 1987).

After leaving the lower American River, emigrant fry rear in the Sacramento-San Joaquin Delta for up to several months. Delta discharge determines rearing location, and high discharge levels result in rearing in Suisun Marsh, San Pablo Bay, and San Francisco Bay (U.S. Fish and Wildlife Service 1987a). Water temperatures above 64 °F stimulate outmigration and can occur in the Delta and upper estuary in May and June (Cannon 1982).

Habitat-discharge relationships for chinook salmon have been the focus of three major American River studies. A 1952 study by the California Department of Fish and Game indicated a sharp decline in spawning area as discharge increased from 500 to 1,300 cfs, but increased spawning area at discharges between 1,300 and 2,700 cfs. The results helped determine the minimum lower American River discharges required by D-893 (Gerstung 1971).

In a 1966 study by Fish and Game, available chinook salmon spawning habitat was found to increase substantially as discharge increased from 500 to 1,500 cfs (Gerstung 1971). This information, along with data on discharge needs of adult and juvenile migrants, was used to develop the minimum lower American River instream flows proposed in D-1400, in the event that the large multi-purpose Auburn Dam was constructed (Figure 23).

The Service's 1981 Instream Flow Study found that flows between 1,750 and 2,000 cfs provide maximum spawning habitat, while flows between 300 and 750 cfs provide maximum rearing habitat. Discharges below 1,250 cfs were not recommended, however, because redds would be exposed and spring water temperatures would exceed juvenile chinook salmon tolerances (U.S. Fish and Wildlife Service 1985).

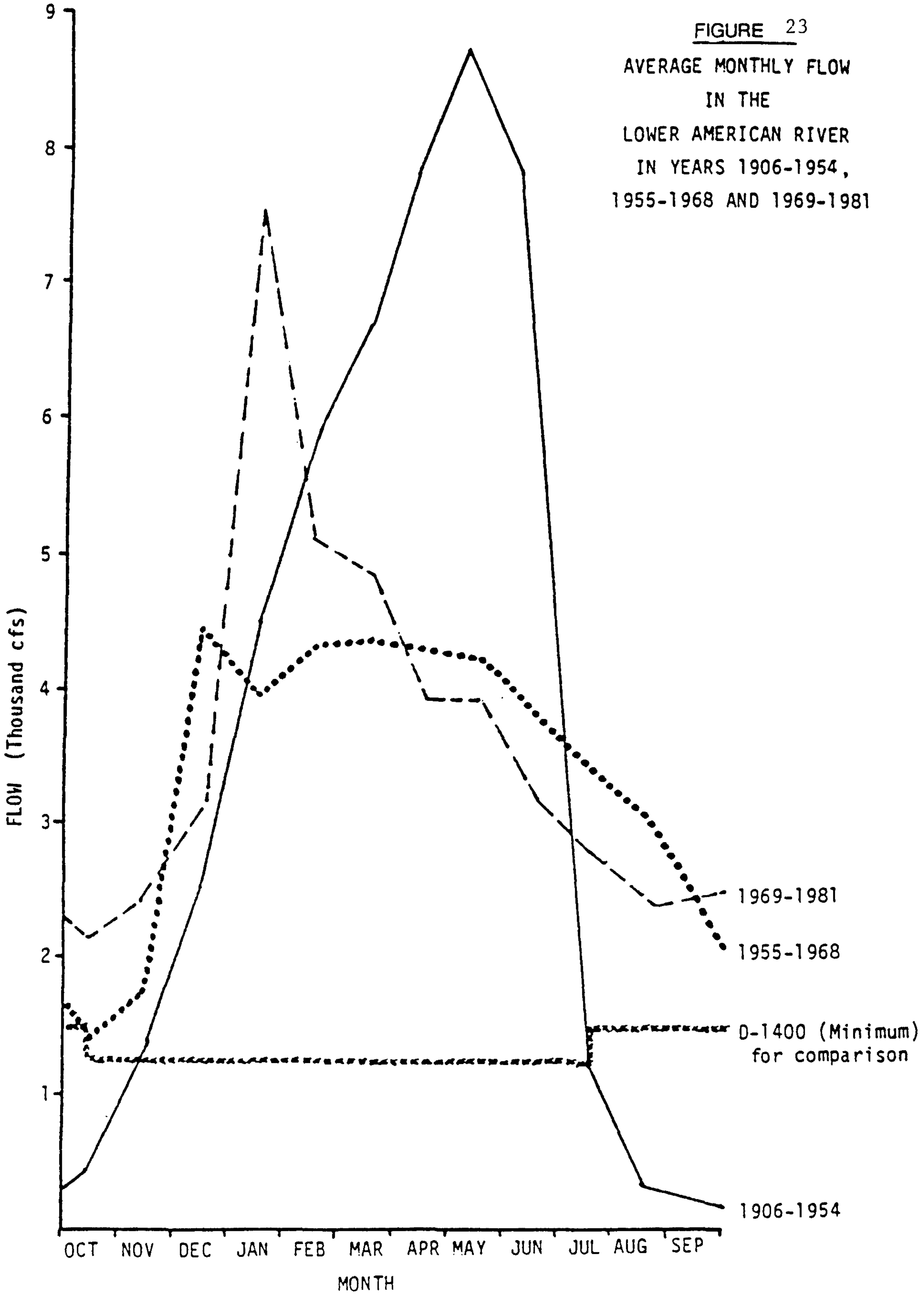


FIGURE 23
AVERAGE MONTHLY FLOW
IN THE
LOWER AMERICAN RIVER
IN YEARS 1906-1954,
1955-1968 AND 1969-1981
FLOW (Thousand cfs)
9
8
7
6
5
4
3
2
1
1969-1981
1955-1968
D-1400 (Minimum)
for comparison
1906-1954
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

Water temperatures affect juvenile chinook salmon growth and survival and are the present focus of much lower American River and lower Sacramento River research. Determining a flow regime on the American River necessary to protect existing in-river fish resources is an important objective. Juvenile chinook salmon in the lower American River experience chronic temperature stress, which is a primary concern during the peak rearing period from April through June (Leidy et al. 1987). Optimum rearing temperatures may be achieved in some months by increasing discharge from Folsom and Nimbus Dams; however, cold water used during the spring reduces the availability of cold water during chinook salmon spawning in fall. As noted earlier, water temperature can be detrimental to egg survival in October and November, affecting both in-river and hatchery production.

Hatchery production is less affected by the existing unsuitable spring temperature regime of the river because the hatchery reared smolts and yearlings are transported and released directly into the Delta. Hatchery-produced fry are usually released in the river before March or April (Ducey pers. comm.).

Adult chinook salmon can also be affected by temperature, particularly in terms of the viability of eggs prior to spawning. Significant losses of naturally-spawned eggs and hatchery-spawned eggs have occurred in the last few years because of high ambient air temperature, low reservoir storage, and warm water releases below Nimbus Dam. Hatchery egg taking operations have been delayed until late November. No studies have quantified these effects, or developed solutions.

Temperatures in the Sacramento River downstream from the American River confluence often exceed optimal juvenile chinook salmon survival temperatures and may be a major factor limiting natural production. Dettman and Kelley (1986) believe the declining run size of naturally produced American River chinook salmon, from 33,000 fish in 1977 to 9,500 fish in 1984, is mainly attributable to increasing Sacramento River water temperatures between the American River confluence and Rio Vista from April through June.

Steelhead trout are anadromous, spending approximately equal proportions of their lives in freshwater and salt water. Steelhead trout enter the lower American River from November through mid-March (Leidy et al. 1987). The run generally peaks in January and February (Gerstung 1971). Limited feeding occurs while in freshwater, and adults return to the sea after spawning.

The original steelhead spawning reaches in the American River were permanently blocked by closure of Nimbus and Folsom Dams. Steelhead are primarily tributary spawners, and because lower American River summer water temperatures increase mortality rates and fishing removes the survivors, few in-river-spawned steelhead survive (Gerstung 1971, Leidy et al. 1987). The American River

adult steelhead trout population is almost totally reliant on the Nimbus Fish Hatchery.

Low river discharge and high water temperatures in the lower American and Sacramento Rivers are probably the two most significant environmental factors affecting American River steelhead (Hallock 1961, Gerstung 1971). A number of other factors affect juvenile steelhead survival, including predation, water diversion, migration barriers, and pollution.

Striped bass are anadromous, spending most of their lives in the ocean or the Bay-estuary and migrating into freshwater to spawn. The primary spawning area is the Sacramento River from Isleton to Butte City. Adult striped bass are found year-round in the lower American River, but their abundance peaks during the summer, generally coinciding with the emigration of adults spawning in the Sacramento River (Gerstung 1971, DeHaven 1980). Striped bass spawning has not been observed in the American River. A few juveniles are in the lower American River year-round, but abundance peaks in the summer. The river appears to be a nursery area for juvenile striped bass (Gerstung 1971).

After spending most of their lives in the Pacific Ocean or San Francisco Bay, American shad begin passing through the Sacramento-San Joaquin Delta in late March or early April. American River spawning migration peaks from mid-May through June (California Department of Fish and Game 1987d).

Nearly all male American shad mature by age 4, and 80 percent of all females mature by age 5 (Wixom 1981). Shad broadcast their eggs and sperm into the currents. One female may release more than 60,000 small, semibuoyant eggs that slowly sink and drift downstream (Davis 1957, California Department of Fish and Game 1986). Most eggs drift into the Sacramento River before hatching in 4-6 days, and few juvenile shad have ever been collected in the lower American River (Painter et al. 1977). American River juvenile shad rear in the Sacramento River below its confluence with the American River and in the Delta.

Run size in Sacramento River tributaries, including the American River, depends on discharge in each river during the run (Painter et al. 1977). When discharge in the American River is high, the shad run typically increases to levels greater than would occur at lower American River discharges. The California Department of Fish and Game recommends American River discharges ranging from 3,000 to 4,000 cfs during the spawning season to sustain the present shad fishery.

The 40 other fish species inhabiting the lower American River are generally considered of secondary importance because their value as commercial and sport fisheries is minor (Gerstung 1971). Warmwater game fish species were all introduced except for the

Sacramento perch, which is rare. Most of the warmwater species reproduce and live in the main river, its backwaters, and adjacent ponds.

Nongame fish is a broad category that includes the anadromous lamprey and many native and introduced species that breed and live in the lower American River. Carp, Sacramento sucker, and Sacramento squawfish could be considered game because they are the focus of recent immigrant peoples who target these species for food (Kelley et al. 1985).

The sport fishery effort for all "other species" is probably less than 5 percent of the effort expended on the four primary anadromous species. However, their importance in the lower American River may be in predator-prey relationships with the major anadromous species and the effects they may have in maintaining the river's ecological character.

Many lower American River warmwater species declined during the first 8 years after closure of Folsom and Nimbus Dams (Gerstung 1971). Water temperatures rarely exceeded 67°F, far below pre-dam maximum temperatures of 75-80°F. Shutters installed in the power intakes in 1962 raised water temperatures to near pre-dam levels. Many species are now more abundant than before the construction of Folsom Dam because summer flows exceed preproject levels by 600 to 1,000 percent (Kelley et al., 1985a and 1985b).

WILDLIFE

Folsom Reservoir

The perimeter of Folsom Reservoir does not support the wildlife species diversity seen downstream of Folsom Dam. The two cover types found in the area, live oak woodland and savanna-grassland, in conjunction with the lake support a variety of wildlife species. However, a significant portion of the perimeter around the reservoir is within the drawdown zone, a relatively lifeless area.

The live oak woodland provides an abundance of trees for nesting and observation sites for red-tailed hawks, American kestrels and other raptors. The extensive, mostly evergreen oak tree canopy surrounding the lake also supplies a rich food source for mast eaters such as scrub jays, black-tailed deer, ground squirrels and gray squirrels. The diverse shrub/herb layer provides cover for many species of songbirds, California quail, bobcat, coyote, gray fox, and rodents. Other characteristic wildlife of this ecosystem include the raccoon, opossum, bats, turkey vulture, acorn woodpecker, western skink, and king snake.

The forbs and grasses of the savanna-grassland serve as the food base for a wide variety of herbivores such as the kangaroo rat,

meadow mice, pocket mice and gophers. Carnivores of this area, which include owls, hawks, coyote, gray fox, gopher snakes and the Pacific rattlesnake, feed upon the abundant populations of mice, gophers, rabbits and squirrels. The savanna-grassland is often the site of human disturbance. This added factor negatively affects the wildlife.

The north fork arm of Folsom Lake is an important area to avifauna. Migratory waterfowl feed and rest in the coves of this area. Anderson Island Natural Preserve supports a heron rookery and the north fork is an important wintering site for several bald eagles.

Lake Natoma

In the Lake Natoma area, wildlife species are basically the same as found along the lower American River. This can be attributed to similar vegetation. An important feature of Lake Natoma is the heron rookery located west of the Willow Creek Day Use Area (California Department of Parks and Recreation 1979).

Lower American River

A diverse assemblage of wildlife occurs within the lower American River floodway. The amount, diversity and quality of the habitat, as discussed in the vegetation section, coupled with existing protective management measures contribute to the high value of this area for wildlife. Each one of the six vegetative cover types along the lower American River has value to wildlife by sustaining resident animals and affording breeding habitat and a corridor, for movement and as a buffer from urban developments. Most wildlife carry out their life functions in more than one cover type. Of the six cover types present in the floodway, freshwater marsh and riparian forest are the most significant to wildlife. Tremendous statewide loss of these two cover types makes them especially significant, locally and regionally.

In California, riparian zones and associated areas support a greater diversity of wildlife than any other terrestrial habitat (Layman 1984). The abundance and diversity of wildlife and the quality of riparian habitats are functions of several interrelated factors, including vegetation structure, area size, microclimatic conditions, habitat diversity, proportion of natural edges, and availability of food, water and cover (Sanders et al. 1985). More mature vegetation complexes, such as the mixed riparian forest contain many of the above-mentioned factors such as natural edges and multiple strata that enhance habitat diversity for wildlife (Thomas et al. 1985). Consequently, the floodway provides a diverse array of feeding and nesting opportunities for wildlife.

More than 220 species of birds have been recorded along the Parkway (Johnson 1982) and over 60 of these nest in Central Valley riparian habitats (Gaines 1974). Common species along the floodway are the great blue heron, mallard, red-tailed hawk, red-shouldered hawk, American kestrel, California quail, killdeer, belted kingfisher, scrub jay, northern flycatcher, tree swallow, and American robin.

More than 30 species of mammals reside along the floodway. Commonly occurring species are striped skunk, Virginia opossum, brush rabbit, raccoon, western gray squirrel, California ground squirrel, meadow vole, muskrat, black-tailed deer, gray fox and coyote.

A substantial number of reptiles and amphibians depend on the indigenous habitats of the lower American River. The most obvious including the western toad, Pacific tree frog, bullfrog, western pond turtle, western fence lizard, southern alligator lizard, western skink, common garter snake, and gopher snake. Population estimates for each species are not available.

For some species, such as beaver, muskrat, water birds and waterfowl, the <u>open water aquatic zone</u> is used for foraging on submerged plants and invertebrates. Waterfowl use the larger areas, such as the dredger ponds, for loafing during their migration.

<u>Freshwater marshes</u> along the American River provide important habitat for wood duck, great blue heron, American bittern, shorebirds, owls, hawks, muskrat, raccoon, opossum, and beaver. Upland species, such as California quail and black-tailed hare take cover and forage at the margins of the freshwater marsh. Reptiles and amphibians including common garter snakes, Pacific treefrog and bullfrog use the marsh for feeding and breeding.

The <u>riparian scrub-shrub</u> cover type provides important foraging habitat for many wildlife species because of its many mast and fleshy fruit-producing plants. Anna's hummingbird, scrub jay, black-headed grosbeak, opossum, raccoon, striped skunk and gray fox commonly feed in this cover type.

The <u>riparian forest</u>, with its multi-layered vegetation and high plant species diversity, supports the largest populations and most diverse wildlife along the lower American River. The high diversity of tree growth stages, cover conditions and layers, and close proximity to water, provide a wide variety of easily accessible habitats and niches. Species that commonly nest in the riparian forest community include egrets, great blue heron, green heron, black-crowned night heron, black-shouldered kite, American kestrel, red-tailed hawk, and red-shouldered hawk. Great horned owl, barn owl and screech owl also often roost in the dense forests. Ringtail cat and western gray squirrel forage

and/or travel almost exclusively in the closed canopy riparian forest.

Important land-water interfaces between the riparian forest and riparian scrub-shrub communities and the freshwater marsh and open water aquatic habitat occur in the pond and backwaters of Sacramento Bar, Arden Bar, Rio Americano, Watt Avenue and Bushy Lake areas. These backwaters provide extremely productive and highly significant habitat for all wildlife species that utilize and greatly benefit from the mix of associated cover types. The highly complex meandering nature of the backwaters is extremely beneficial to wildlife. Meandering greatly increases the edge effect between aquatic and upland habitat as compared to confined linear portions of the floodway. The dense vegetation and abundance of wetted shoreline areas associated with the ponds and backwaters create a buffer against some of the human disturbance occurring in the floodway. The highly complex vegetation structure and relatively low human disturbance of these ponds and backwaters, result in greater populations and diversity of wildlife species per acre. In addition, wildlife utilize these areas much more than the narrow linear portions of the American River floodway.

In the upland areas of the floodway, many raptors, including red-tailed hawk and black-shouldered kite nest in the sturdy canopy of the <u>valley oak and evergreen woodlands</u>. Older cavity-ridden trees are heavily used by cavity-dependent species, such as acorn woodpecker, downy woodpecker, hairy woodpecker and plain titmouse. Black-tailed deer and wild turkey also feed in the valley oak woodland. In the more open canopy of the valley oak stands, Lewis' woodpecker and the ash-throated flycatcher forage. The grassland community is most apparent in the open stands of valley oak. Such sites are important as foraging sites for raptors and deer. In addition, yellow-billed magpie, loggerhead shrike, western meadowlark and a variety of sparrows commonly use grasslands for nesting and/or foraging.

Summary

Generally, the great abundance and diversity of natural plant communities and their associated wildlife within the riparian corridors throughout the Central Valley have been destroyed at alarming rates. The American River Parkway remains as one of the largest protected riparian areas in the Central Valley, a tribute to concerned citizens planning for the future. Due to local and statewide decimation of riparian areas, preservation of the integrity of the lower American River is critical to many species of resident and migratory wildlife; it is a sanctuary amid the growing urban sprawl of Sacramento.

ENDANGERED SPECIES

Federally Listed Species

Two federally listed species have been identified as occurring or potentially occurring around Folsom Reservoir and Lake Natoma and within the 23-mile-long lower American River riparian corridor below Nimbus Dam (USFWS 1989, California Department of Fish and Game 1989). These species are the state and federally listed endangered bald eagle, and the federally listed threatened valley elderberry longhorn beetle. The winter-run chinook salmon, a federally listed threatened species, has not been identified as occurring in the lower American River system.

Bald Eagle FE, SE
Haliaeetus leucocephalus

Our limited information on bald eagle use within the study area consists mostly of available field notes, personal communications and correspondence with local Audubon members or other birders. According to information from Ted Beedy, a local biologist and ornithologist, the bald eagle occurs as a winter visitor around Folsom Reservoir, Lake Natoma and along the lower American (pers. comm. 1989). David Johnson (local Audubon member, pers. comm. 1989) reports that bald eagles are not observed very frequently or consistently in the lower American River even during the winter, but that around Folsom Reservoir as many as 10-12 wintering bald eagles have been observed. The California Winter Bald Eagle Surveys 1979-1982 (Detrich 1981 and 1982) do not include the lower American River in the sites reported for wintering bald eagles; however, at Folsom Reservoir, the numbers of eagles reported ranged from one to seven during the 1979-1982 winter surveys. Sightings along the lower American River and in the Lake Natoma area may have been some of the Folsom birds foraging down the river (Beedy pers. comm. 1989, American River Committee 1988).

Few specific data on wintering bald eagle use of the study area are published or recorded in a systematic manner. Consequently, the following discussion of bald eagle use within the lower American River riparian corridor represents the presumed circumstances under which bald eagles use the area based on discussion with local bird observers. Sightings on the lower American River likely occur in relatively isolated areas with minimal human disturbance and probably in or near shallow riffle areas where dead fish would wash up and be easily located by a foraging eagle. Specific "hot spots" where wintering eagles are consistently seen are unknown, but they have been observed as far downstream as Watt Avenue (Ted Beedy, pers. comm. 1989). Most bald eagle sightings around Folsom Reservoir occur in the north fork arm of the reservoir (California Department of Parks and Recreation 1979).

There have been no recent or historical reports of bald eagles nesting in the study area, although it is presumed that they did nest along the upper and lower American River historically. Today, intensive human use and the almost continual human presence in the Parkway and around Folsom Reservoir during the nesting season may be important disturbance factors preventing bald eagles from nesting in these areas.

Based on the above winter survey reports, it appears that the Folsom Reservoir and lower American River areas together compare in importance to other key wintering areas in Zone 27 of the Bald Eagle Recovery Plan such as the Payne's Creek/Inks Creek, Mill Creek/Deer Creek and Woodson Bridge/Colusa areas (USFWS 1986a).

Valley Elderberry Longhorn Beetle FT
Desmocerus dimorphus californicus

As part of the American River Watershed Investigation the Fish and Wildlife Service conducted reconnaissance level surveys for the valley elderberry longhorn beetle in the lower American River study corridor.

Although elderberry shrubs commonly occur around Lake Natoma and Folsom Reservoir these areas were not included in the Watershed survey areas. The Corps is conducting surveys of the Lake Natoma and Folsom Reservoir areas separately.

Maps of existing and potential elderberry occurrence were prepared for the lower American River riparian corridor using the presence of elderberry bushes and their habitat as an indication of habitat suitability for the beetle.

Other Species of Concern

Eighteen additional species of concern, including eight State-listed species(six of which are Federal candidate species), nine Federal candidate species and one federally protected species, have been identified as occurring or potentially occurring in the study area (Table 4).

Table 4. Species of Concern

Species	Status	Area	Habitat
California spotted-owl Strix occidentalis occidentalis	FC2	3	Dense canyon woodlands and forests.
swainson's hawk Buteo swainsoni	ST	1,2,3	riparian forest, grasslands

bank swallow Riparia riparia	ST	1,2,3	cut banks of rivers, streams, and sloughs
California red-legged frog Rana aurora draytoni	FC2, SC	1	freshwater marshes, isolated seasonal and permanent wetlands
giant garter snake Thamnophis gigas	FC2, ST	1	freshwater marsh, seasonal wetland
California tiger salamander Ambystoma tigrinum californiense	FC2, SC	1	freshwater marsh, seasonal wetland
Sacramento Valley beaches **tiger beetle** Cicindela hirticollis abrupta	FC2	1	undisturbed sandy
Sacramento anthicid beetle Anthicus sacramento	FC2	1	sand deposits, sandy beaches
valley sagittaria Sagittaria sanfordi	FC2	1	shallow, fresh water marshes, backwater areas and waterways
Red Hills soaproot Chlorogalum grandiflorum	FC2,	3	lithospecific, serpentine
Bisbee Peak rush-rose Helianthemum suffrutescens	FC2,	3	lithospecific, serpentine
El Dorado County mule ears Wyethia reticulata	FC2	3	lithospecific, serpentine
Black-shouldered kite Elanus caeruleus	FP	1,2,3	
El Dorado morning glory Calystegia stebbinsii	FC2, SE		
Pine Hill ceanothus Ceanothus roderickii	FC2, SR		
Pine Hill flannel bush Fremontodendron decumbens	FC2, SR		
El Dorado bed straw Galium californicum subsp. sierrae	FC2, SR		

Layne's butterweed FC2, SR
Senecio Layneae

Sacramento splittail FC2
Pogonichthys macrolepidotus

FE = Federally listed as Endangered, FT = Federally listed threatened, ST = State listed Threatened, FC2 = Federal candidate (a species which may be endangered or threatened but which requires additional information to confirm its precise status), FP = Federally protected, SC = State species of concern. Area 1 = lower Amer. Riv., 2 = Lake Natoma, 3 = Folsom Res.

State-Listed Species

Swainson's hawk ST
Buteo swainsoni

This raptor historically was as abundant in California as the red-tailed hawk (Schlorff and Bloom 1984). Dramatic declines in the species distribution and abundance in California coincide with the documented rapid conversion of riparian habitats and adjoining grasslands to agriculture and urban development. These documented declines prompted the California Fish and Game Commission to designate the Swainson's hawk a threatened species under the California Endangered Species Act in 1985.

Both foraging and nesting habitat for Swainson's hawk exists throughout the lower American River riparian corridor and in the Lake Natoma and Folsom Reservoir areas. The total amount of useable habitat, however, is largely limited in the lower American River corridor as a consequence of the narrow dimensions of the floodway. Additional constraints in this area include limited amounts of large grasslands suitable for foraging, and high levels of human activities within the parkway, especially during the nesting season.

Some areas of the lower American River appear more suitable than others for Swainson's hawk. Those portions of the Parkway that are widest between the levees probably offer the most suitable sites as a consequence of greater habitat diversity typically present. Several such areas appear to support the appropriate mix of suitable nesting habitat (dense riparian forest) and adjoining large grasslands for foraging.

Details on Swainson's hawk use around Lake Natoma and Folsom Reservoir are limited to field notes and information from local bird observers.

Bank swallow ST
<u>Riparia riparia</u>

This species has a localized distribution in California occurring almost exclusively along watercourses (rivers, streams and soil-lined canals and sloughs) that provide mostly steep, vertical earthen banks and bluffs. Such bank sites, which are virtually always composed of sandy-loams or compactible gravels, provide critical nesting sites for this colonial bird.

The species, which was once numerous throughout California's riparian habitats, has declined precipitously since historic times (Remsen 1978, Laymon et al. 1987). Although the specific reasons for the decline are largely unknown, bank stabilization for flood control, as well as other disturbances associated with human developments have been implicated as major contributors to the decline of the species (Remsen 1978, Fish and Wildlife Service 1986b). As a consequence of the documented declines in species numbers and distribution, the bank swallow was listed as a threatened species under the California Endangered Species Act in 1989.

Little information exists regarding historical bank swallow use on the American River. Presumably, prior to the massive human developments and alterations of the river corridor that exist today, bank conditions suitable for the swallow likely occurred along most of the lower river up to the areas where the Victor formation exists as the primary channel bed material. Below this point, sand bars and cut banks typical of a meandering valley stream/river undoubtedly were a common feature of the pre-development river channel (Watson 1985). Above the hard bedrock formations, some seemingly suitable banks exist around Lake Natoma but any former sites on the upper river above Folsom Dam were eliminated with the filling of the reservoir.

As a consequence of the major physical changes in the hydrology and stream channel conditions since completion of Folsom Dam, the much-reduced meander dynamics of the lower American River today offer limited steep cut-bank habitat for the bank swallow. Under existing regulated flow conditions, the most likely area for the bank swallows on the lower American River occurs near the mouth adjacent to Discovery Park. A large cut bank exists on the north bank, across from the Rusty Duck restaurant, extending approximately 200-300 feet along the river edge. Although bank swallows were not observed during the course of our brief surveys, this cut bank appears to provide suitable nesting habitat.

Giant garter snake ST, FC2
Thamnophis gigas

The historical range for this snake included a large portion of the Central Valley from the Colusa Basin and Butte Sink in the Central Sacramento Valley, to as far south as the Buena Vista lake in western Kern County. Today the species appears to have been extirpated from the entire San Joaquin Valley for a variety of reasons (Hansen unpubl.). Levee and waterway maintenance practices that prevent emergent vegetation from growing on the banks of sloughs, canals and other waterways and wetlands is considered one of the most likely reasons for the species absence in the San Joaquin Valley, and the presence of introduced predatory fishes is another factor commonly cited as affecting the suitability of remaining wetland habitats in the range of this species. The large number of predatory fishes in the Sacramento/San Joaquin Delta and in large reservoirs such as Folsom and Natoma may be the reason for the species absence in these areas.

As a consequence of the dramatic reductions in the species distribution and abundance noted above, the giant garter snake has been granted legal protection as a threatened species under the California Endangered Species Act. Also, the American Fisheries Society has petitioned the Fish and Wildlife Service to list the giant garter snake. It is presently under review by the Service for possible listing under the Endangered Species Act of 1973, as amended (54 CFR 554).

In the Sacramento region, the species has been recorded from the Elk Grove/Laguna Creek area in the south to the Woodland-Liberty Farms west of the Yolo Bypass and throughout the American Basin. Although no sightings are known from the lower American River, Natomas East Main Drain (NEMD), or the drainages to the east, several areas of presumably suitable habitat occur all along the NEMD and within Dry Creek and Arcade Creek which flow westward into the NEMD.

Within the lower American River corridor, several areas appear suitable for the giant garter snake, although there are no documented observations. Most of the lower American River Parkway appears unsuitable based on the swift flow conditions of the river and the presence of large numbers of predatory fishes in the main channel and contiguous backwater areas. In addition, the intensive, almost continual human use of the parkway and the high proportion of densely shaded wetland habitat appear to further limit the potential for this species. Nonetheless, some of the more isolated and open wetland ponds disjunct from the main river appear to provide habitat of high potential to support this snake. Suitable areas include the isolated gravel bar ponds scattered from near Nimbus Dam down to Goethe Park, as well as

some of the isolated channels and ponds further down-gradient from the Cal Expo area to the mouth. The lower section of the NEMD, where it enters the American River Parkway also offers high potential for this species.

California tiger salamander SC, FC2
Ambystoma tigrinum californiense

This salamander is a species of seasonal ponds and permanent wetlands of central California, primarily the San Joaquin Valley. The species is not known from the immediate Sacramento area although specimens have been collected from the vicinity of Rancho Seco and the city of Galt in the south part of the County. The northernmost occurrence in the Central Valley is near Dunnigan in Yolo County.

Rapid declines in the vernal pool and seasonal wetland habitats throughout the historic range of the tiger salamander give reason for concern over the future long-term viability of this species. Although the species is not protected under either the California or Federal Endangered Species Acts, the California Department of Fish and Game considers it a species of special management concern (John Brode, CDFG, pers. comm. 1989).

The species typically occurs in association with seasonal wetlands and certain permanent wetlands and marshes. Typically suitable sites support varying degrees of emergent vegetation, and standing to only slightly flowing water. In many valley areas, the waters can be somewhat alkaline (Marc Hayes, unpubl account). Although no collections or sightings have been recorded in the Sacramento region, vernal pools and shallow seasonal ponds are the most likely areas for this species to be found. In the lower American River corridor, likely areas for the tiger salamander would be the more seasonal wetland habitats suitable for the similarly adapted giant garter snake.

Red legged frog SC, FC2
Rana aurora

At one time this species was the common frog of the Central Valley and coastal wetlands, ponds and waterways. It historically occurred in a wide variety of settings including humid forests, woodlands, grasslands and streamsides, especially where emergent and streamside vegetation provide cover (Stebbins 1985).

Intensive collecting for frog legs during the late 1800's and early 1900's undoubtedly contributed to its decline in the Central Valley. The introduced bullfrog also has had a major effect on the distribution of the species. Today it is a species

of concern to the California Department of Fish and Game because of its greatly reduced range.

The lower American River corridor provides some apparently suitable habitat for this species, although there are no historical records of its occurrence there. Sites of particular potential include those suitable for the giant garter snake as well as any of the more shaded isolated ponds within the corridor that lack bullfrogs or other large aquatic predators.

Sacramento Valley tiger beetle FC2
Cicindela hirticollis abrupta

This tiger beetle inhabits clean sand along riverbanks and sand bars in the Sacramento Valley. It has been recorded from Sacramento, Yolo and Sutter Counties (Graves 1988).

Adult tiger beetles are highly active terrestrial predators that are well equipped morphologically for stalking and hunting small arthropods. Cicindela will eat any arthropod they can overpower, such as isopods, moths, ants, and flies. In addition to being able to run very quickly, tiger beetles are agile fliers. They are wary and extremely difficult to approach, taking flight rapidly and alighting some distance away from the pursuer. They are most active during periods of warm sunshine in the spring, summer, and fall.

The predaceous grub-like larva inhabits a vertical burrow in the sandy soil in the same general vicinity as the adults. It positions itself at the entrance to the burrow ready to capture any passing arthropod. The larva has spines on the fifth abdominal segment which it drives into the side of the burrow if the prey threatens to pull it out of the burrow. It uses its hook-like mandibles to kill the victim, which is then taken to the bottom of the burrow and eaten. Further information on the ecology and biology of tiger beetles is given in Pearson (1988).

This species is extremely sensitive to physical disturbance of its habitat. Several related tiger beetle subspecies have been affected adversely by urban development, stream and river channelization, and uncontrolled recreation, such as ORVs and beach goers (Graves et al. 1988). Thus, the intensive human use and associated recreational activities typically found on the sand bars and beaches of the parkway during the spring and summer may limit the potential occurrence of the species along the lower American River.

Sacramento anthicid beetle FC2
Anthicus sacramento

The Sacramento anthicid beetle inhabits areas with loose sand at the mouth of the Sacramento River in the Delta Region (Chandler

1978) and the dunes of Ord Ferry Road Bridge in Butte County (Hagen undated). It is not known from the immediate Sacramento area although it is possible further sampling will reveal the presence of this species because of the presence of similar habitat.

Mating and oviposition occur in the spring, and by early summer, the new generation of adults emerge. Adults have also been collected in the fall and winter (Hagen undated). This species, like others in the genus, is probably an omnivore feeding on small invertebrates and other organic material.

The larvae of A. sacramento are likely to be found inhabiting areas beneath low sprawling plants and plant debris on the beach and other sandy habitats (Chandler 1978). This beetle appears to prefer more recently accumulated loose sands as evidenced by its association with recently deposited spoil sands in the Delta area. Consequently, it may be less sensitive to human presence than the Sacramento tiger beetle. Hagen (undated) felt that the introduced Argentine ant (Iridomyrmex humilis) was adversely affecting the Sacramento anthicid beetle.

Valley sagittaria FC2
Sagittaria sanfordi

This herbaceous emergent aquatic plant typically occupies standing or slow-moving shallow waters of valley streams, ponds, channels, canals and sloughs. The historical distribution of this species included the above types of wetland habitats throughout portions of the Central Valley. Two additional disjunct populations have been reported to occur in Del Norte and Santa Barbara Counties (USBR 1984).

Many historical sites have been eliminated as a consequence of canal and slough maintenance activities and removal of emergent vegetation. Use of aquatic herbicides has undoubtedly eliminated many former populations in the agriculturally dominated Central Valley. The noted reductions of range and abundance of this plant prompted the U.S. Fish and Wildlife Service to place it under review (50 FR 39526) for possible listing under the Endangered Species Act of 1973, as amended.

In 1987, four populations were known to remain (C.E. Turner, USDA Biological Control Office, 1050 San Pablo Avenue, Albany, CA 94706, pers. comm. 1987). Surveys along the lower American River by Dr. Robert Holland and Ms. Ginny Dains confirmed two colonies, one near Watt Avenue and another near Rio Americana High School. It is highly possible that additional colonies occur in the wetlands and waterways of the Sacramento region.

WITHOUT THE PROJECT

VEGETATION

Folsom Reservoir

Under without-project conditions, vegetation in, and surrounding, Folsom Reservoir would not change significantly from existing conditions over the period of analysis. The California Department of Parks and Recreation would continue to manage the area as it does today.

Lake Natoma

Without the project, no significant change in vegetation would likely occur in, and surrounding, Lake Natoma. As with Folsom Reservoir, management of the area by the California Department of Parks and Recreation would be similar to existing conditions.

Lower American River

Under without-project conditions, vegetation in, and along, the lower American River would continue to change slowly as it has since the construction and operation of Folsom Dam, and be subject to floodway activities such as gravel mining, bank riprapping, and bridge construction (Table 5).

In the upper subreach, as gradual channel downcutting and localized channel widening continue, gravel bars would become fewer, less vegetated, and coarser as fine sediments are scoured and lost to downstream areas. In both upper and lower reaches, vegetation patterns and species assemblages associated with depositional features such as new terraces, sandbars, shoals, and low sand plains would gradually decline without replacement. Early successional woody species such as cottonwood, willow, alder, and other active zone shrubs would likely decline, existing in continually smaller patches and on narrower margins of the active channel as suitable substrate conditions slowly decline in the more erosion-prone sites. This decline would also reduce active zone scrub-shrub habitat. The rates of decline would vary from site to site depending on localized conditions. We estimate an overall change in riparian forest conditions during the 100-year period of analysis of about 50 percent.

By nature of the greater channel stability, continued downcutting, and net sediment movement downstream, the higher terraces of the border and outer zones likely would experience floodflows at increasingly less frequent recurrence intervals. Similarly, some of the land area available for terrestrial

Table 5. Changes in Habitat Cover Type Acreages under Without-Project Conditions (1995-2095)

Habitat Cover Type	Existing	Without-Project	Change
Wetland			
Open water	313	181	-132
Freshwater marsh	49	27	- 22
Riparian scrub-shrub	2290	1532	-758
Riparian forest	1350	782	-568
Upland			
Oak woodland	0	114	114
Grassland	430	1796	1366
Grain	561	561	0
Total Acreage	4,993	4,993	

vegetation would slowly decline adjacent to the active channel as the finer terrace sands and soils continue to move inexorably downstream without replacement from upstream. Less frequent flooding in side channels and backwaters could result in decreases in marsh and open water habitats and their conversion to grasslands.

Cottonwood would decline in dominance and importance in the border and active zone forests over time. This is expected because a proportion of the older cottonwood trees within the floodway would likely die as a consequence of the apparent older age structure of the cottonwood population. In contrast, other woody species on the terraces would continue to slowly mature to forest complexes dominated by species adapted to a relatively high water table, infrequent flooding with subsequent low-intensity substrate perturbations, and tolerant of intense competition for space. Thus, species such as valley and live oaks, ash, and box elder might increase slightly in importance and coverage over this period in the mixed riparian and cottonwood forests of the border and outer zones. In addition, certain border and outer-zone shrubs on high terrace sites might increase to a slight extent over the project life.

Pasture habitats also would not change significantly from existing conditions. Grassland and herbaceous habitats would actually increase as old cottonwood trees die and fall over, creating openings in the canopy.

Clearly, the existing alterations, reductions, or, in some cases, losses of important riverine processes have resulted from the damming of the river and implementation of the existing flow

regime. Thus, existing reservoir management and subsequent flow and sediment processes are significantly affecting the course and rates at which the riparian vegetation of the lower American River is changing. Although the rates and eventual conditions will become more apparent as time passes, it now appears that, ultimately, the structure and species composition of the entire lower river floodway will slowly and inexorably change to what may be a less diverse, probably lower-productive system. Although the rates of change and decline are unknown at this time, it is clear that future operations and other management actions in the watershed will continue to significantly influence the dynamics of the system.

FISH

Folsom Reservoir

Without the project, some decline of the fish resource of Folsom Reservoir would be expected. Projected growth of in-basin water demand (above and below Folsom Reservoir) would increase existing reservoir water level fluctuations and drawdown. This would exacerbate the low productivity of the reservoir. Unsuccessful spawning of many species (sunfish) would continue, causing a further decline in reservoir fish population.

In addition, as residential and commercial developments surrounding the reservoir increase, the inflow of contaminants and sediments to the reservoir would increase. This would further impact fish production as spawning areas are covered by sediments and eggs and young are exposed to contaminants.

Fishing pressure would increase somewhat because of the substantial increase in population of the area. However, the increase would be minimal as the catch per effort declined. Average annual angler-use expended at the reservoir would remain essentially at the existing level of about 120,000 days.

Lake Natoma

No significant change would take place at Lake Natoma. Since natural fish production does not exist, the California Department of Fish and Game would probably continue fish planting to maintain resource levels. Therefore, average annual angler-use would remain at the existing level of 150,000 days.

Lower American River

A decline in anadromous fish population would occur under without-project conditions. As in-basin water demands increase, Delta water quality releases are made, and water exports increase, streamflow in excess of Fish and Wildlife Service's

recommendations (1985) that now occur during most years would decrease. Reduced flows would primarily impact naturally spawning chinook salmon and American shad, as water temperatures increase, general water quality declines, summer flows fluctuate, and the quality and quantity of the spawning gravels decline. In addition to the decline of natural spawning, hatchery production of chinook salmon and steelhead trout would decrease at the Nimbus Hatchery because of increased water temperature and overall reduced water quality. The State's Anadromous Fish Hatchery Program, however, would not be impacted as severely as natural production, primarily because it is less affected by (1) low fall spawning flows, (2) erratic water levels, (3) scouring flows during incubation, and (4) low spring-emigration flows.

Excluding current efforts to modernize the hatchery, chinook salmon production numbers would be expected to decline by at least 10 percent from 197,600 to 178,000 (Table 6). This would result in the average annual decrease of commercial salmon catch from 991,000 pounds valued at $2,775,000, to 889,000 pounds valued at $2,481,000. Average annual angler-use for salmon ocean sport and freshwater sport fisheries would remain about the same because of increased effort. Average annual angler-use would remain at 60,600 days for ocean and 100,000 days for freshwater sport fishing. Steelhead trout numbers would decline because of some decrease in hatchery production; however, average annual angler use would remain essentially at the existing level of 27,700 days. American shad numbers would decline slightly.

Table 6. Average Annual Lower American River Chinook Salmon Production

	Existing Condition	Without Project Condition*
Escapement (spawners)	47,500	42,750
Production	197,600	177,840
Harvest:		
Ocean commercial catch	90,100	81,090
Ocean sport catch	48,000	43,200
River sport catch	12,000	10,800
	150,100	135,090

* Assumes a 10% loss of production due to increased water demands and reduced instream flows.

Other species of fish, such as striped bass, largemouth bass, bluegill, crappie, and other game and nongame species would be adversely affected by increased water temperature, changes in seasonal flow, low summer flows, decreased flooding of the backwater areas, and general degradation of water quality.

Striped bass, smallmouth bass, and largemouth bass would be impacted the most. However, the impacts on these and other species would not be significant.

WILDLIFE

Folsom Reservoir

Under without-project conditions, no significant change to wildlife species inhabiting the area would be expected.

Lake Natoma

Without the project, no significant change to wildlife species in, and adjacent to, Lake Natoma would occur.

Lower American River

Under without-project conditions, gradual habitat changes would occur as vegetation changes in response to Folsom Reservoir and other upstream reservoir operations. Gradually, old cottonwoods and willows along the river would be replaced by alders, thereby reducing wildlife wetland values by about 50 percent. Wildlife species that would be impacted are species that prefer cottonwoods and willows for perching, foraging, and/or nesting. These include raptors, woodpeckers, flickers, wrens, and many other birds that use these areas to meet one or all of their life requirements.

The changes in streamflow would also adversely affect backwater wildlife habitat; those areas flooded periodically by high steamflows. This loss, however, would not be significant under without-project conditions. Also, some wetland areas would be converted gradually to grasslands. This would adversely impact wildlife that use these wetland areas; the effects would be significant. If current flow regimes and release patterns continue, a significant area would be converted. The conversion to grassland vegetation would provide habitat for wildlife species such as raptors, reptiles, rodents, and jackrabbits.

WITH THE PROJECT

VEGETATION

Folsom Reservoir

Increasing the flood control storage space in Folsom Reservoir, a feature of the 100-Year (FEMA) Storage, 100-Year (FEMA) Levees/Storage and 150-Year Protection alternatives, would have no significant adverse impact on terrestrial vegetation in, and adjacent to, Folsom Reservoir. Because the affected area lies below the existing drawdown zone, there is no vegetation. There

could, however, be some adverse impact on established backwater marsh areas that are now inundated at the 400,000 acre-foot storage level. These areas would be dewatered. However, since a portion of the drawdown season occurs when woody vegetation is dormant, any adverse effect would be reduced.

Lake Natoma

Increasing flood control storage at Folsom Reservoir would have little adverse effect on existing vegetation. Lake Natoma would continue to fluctuate within existing ranges; therefore, no additional vegetation would be exposed or inundated.

Lower American River

Raising and extending levees and riprapping banks and levees along the lower American River to increase its channel capacity, and widening the Sacramento Bypass would adversely impact valuable and scarce riparian forest and scrub-shrub cover types (wetlands) and upland cover types. Riparian forest, marsh, and scrub-shrub located adjacent to the existing levees would be lost over without-project conditions. Since the area would become part of the levee system and maintained, recolonization of these areas by riparian forest and scrub-shrub species would not be allowed.

Grassland vegetation on the existing levee berms and adjacent landside fields would be lost, but after construction, those areas would be allowed to revegetate with grasses. Therefore, the loss of wildlife value would be temporary (2 to 3 years after construction) and the areas would recover essentially to preproject condition.

The timing of water releases from Folsom Reservoir to the lower American River would change. Flows and impacts would differ, depending on the water year classification, but, in general, there would be a decrease in mean flow peaks in early spring. This change would reduce spring scouring flows and inundation of the active zone (point bars, eroding banks and areas behind banks) where early plant succession occurs. There would also be a reduction of inflow to backwater areas, side channels and gravel ponds. The timing of water releases would further exacerbate the adverse changes caused by the construction and operation of Folsom Dam. The natural diversity of riparian vegetation would be reduced further by the altered streamflow and sediment regimes.

Also summer flows would increase, causing adverse impacts to species of both the active and border zones. Many moderate- to low-tolerance border zone trees and shrubs such as cottonwood, elderberry, various oak species, blackberry, sycamore, ash and boxelder would decline with increasing summer irrigation. The

result would be a general lowering of the habitat and woody species diversity and narrowing of the border zone habitats.

Regeneration and maintenance of a highly diverse riparian area is dependent upon properly timed, periodic high- and low-intensity flooding and sediment deposition. Moist banks with newly deposited sediments in the early spring typically provide regeneration sites for young growth willow-cottonwood forests. Without these processes, much of the area would slowly change from riparian forest, scrub-shrub, and emergent marsh to oak-grassland. Over the project life, a conversion would occur. Net changes in wildlife cover acreages (with and without project) are shown in Tables 7, 8, 9 and 10.

FISH

Folsom Reservoir

Except for the 100-Year (FEMA) Levees alternative, many of the existing fisheries problems would be exacerbated. With an increase in the flood storage pool, water level fluctuations in the reservoir would worsen, thereby further impacting warmwater fish spawning (April-June period). Evacuation of the reservoir flood storage pool would alter existing thermocline patterns, reduce the cool water storage pool, reduce the shallow littoral zone habitat (the most productive area of a reservoir), and increase predation on smaller fish which normally seek shelter in shallow water.

The loss of cool water and change in thermocline would essentially eliminate the coldwater fishery of Folsom Reservoir. Land-locked salmon and rainbow trout would not survive the summer without cool, deep, well-oxygenated water. Annual stocking of rainbow trout could be continued to provide fishing; however, the present carryover of larger-size fish to the following winter and spring would not occur. The degradation of the fish resource of Folsom Reservoir would result in a corresponding decrease in fishing in the reservoir. For the 150-Year Protection alternative, average annual angler-use would decrease to 92,500 days, a decline of 27,500 days over the period of analysis, as follows:

Year	1	50	100	Average Annual
Angler Days	120,000	90,000	80,000	92,500

Trends between years are straight line and each angler-day is valued at $31.

Table 7. 100-Year (FEMA) Levees Wildlife Cover Types (acres)

Wetland Cover Type	Without Project	With Project	Difference
Marsh	27	22	- 5
Open water	181	56	-125
Riparian forest	782	675	-107
Scrub-shrub	1,532	1,307	-225
Subtotal	2,522	2,060	-462
Upland Cover Type			
Grassland	1,796	2,357	561
Woodland	114	131	17
Grain	561	364	-197
Riprap	0	81	81
Subtotal	2,471	2,933	462

Table 8. 100-Year (FEMA) Levees/Storage Wildlife Cover Types (acres)

Wetland Cover Type	Without Project	With Project	Difference
Marsh	27	27	0
Open water	181	56	-125
Riparian forest	782	676	-106
Scrub-shrub	1,532	1,309	-223
Subtotal	2,522	2,068	-454
Upland Cover Type			
Grassland	1,796	2,153	357
Woodland	114	132	18
Grain	561	559	- 2
Riprap	0	81	81
Subtotal	2,471	2,925	454

Table 9. 150-Year Protection
Wildlife Cover Types (acres)

Wetland Cover Type	Without Project	With Project	Difference
Marsh	27	6	- 21
Open water	181	56	-125
Riparian forest	782	534	-248
Scrub-shrub	1,532	1,247	-285
Subtotal	2,522	1,843	-679
Upland Cover Type			
Grassland	1,796	2,937	1,141
Woodland	114	132	18
Grain	561	0	- 561
Riprap	0	81	81
Subtotal	2,471	3,150	679

Table 10. 100-Year (FEMA) Storage
Wildlife Cover Types (acres)

Wetland Cover Type	Without Project	With Project	Difference
Marsh	19	18	- 1
Open	72	66	- 6
Riparian forest	707	652	-55
Scrub-shrub	1,472	1,391	-81
Subtotal	2,270	2,127	-143
Upland Cover Type			
Grassland	1,568	1,700	132
Woodland	103	114	11
Subtotal	1,671	1,814	143

Lower American River

Increasing the river channel capacity to convey flows up 180,000 cfs would have no measurable adverse impact on fish resource. Since storm events that require downstream releases of either 115,000 or 180,000 cfs are rare, and the difference in hydraulic effects between the flows small, any additional impact over existing and without-project conditions would not be

significant. However, some loss of spawning gravels would occur as higher flows are released down the river. Since Folsom Dam precludes gravel replenishment in the lower river, the long-term impact to naturally spawning chinook salmon and other fish would be adverse.

The greatest impact on fish resources, especially anadromous species, would result from the increase in flood control storage at Folsom Reservoir. Increasing the flood storage pool would reduce fall chinook salmon spawning flows in dry and critical water years, significantly decreasing spawning success. Reduced flows would decrease the amount of usable spawning habitat in the river, thereby crowding fish into the remaining areas. This would result in later-arriving salmon spawning over existing redds so that early redds would be lost.

In addition, increased flood control space in Folsom Reservoir would reduce the pool of coldwater in the reservoir, resulting in downstream water temperature increases. An increase of water temperature during the month of November would have a significant adverse impact on naturally spawning stock of the lower American River over existing and without-project conditions. Although these conditions would not occur annually, increased water temperature during this period would eventually eliminate natural spawning of chinook salmon in the river.

Also, greater flood control space would increase spring water temperatures in the month of April above existing without-project levels. Suitable water temperatures would be exceeded more often, causing additional stress and probably increased losses in emigrating salmon smolts.

American River chinook salmon must reach a minimum size of about 75 mm (fork length) before mid-May to June if they are to successfully outmigrate as juveniles. Those that do not are forced to over-summer in the river. However, because of higher water temperatures in the lower reaches, these juveniles concentrate in the reach immediately below the Nimbus Dam where they are subject to intense competition and predation, thus few survive. These adverse conditions would become more common under with-project conditions.

With the 150-Year Protection alternative, chinook salmon numbers would decline (Table 11). Average annual spawning production would decline to 140,620 salmon, 37,220 fish less than under without-project conditions. The ocean commercial catch would decline from an annual average of 891,900 pounds with a value of $2,489,000 to 705,000 pounds valued at $1,968,000. The chinook salmon sport catch would also decline from 54,000 fish to 43,000 fish, with a resulting average annual decline in ocean and freshwater sport fishing of 4,100 and 5,600 angler-days, respectively. The foregoing values would be 3 percent greater

with 100-Year Storage alternative, and 4 percent greater with the 100-Year Levees/Storage alternative.

With all alternatives, steelhead numbers would remain relatively constant because the run is essentially dependent on hatchery production. The 8,000 to 10,000 fish that spawn in the lower American River evidently do not produce returning adults. The existing rearing habitat in the river is not conducive to steelhead production. Since hatchery production would remain as under without-project conditions, average annual angler-use is expected to remain at 27,700 days.

Neither would the alternatives have a significant adverse impact on American shad, striped bass, and other game species in the river. American shad and striped bass would continue to ascend the river to spawn and feed. Shad fishing would probably be more successful at moderate spring flow. However, angler-use would remain at an average annual of 75,000 and 8,000 days, respectively, for American shad and striped bass. Angler-use for other game species would remain as under without-project conditions.

WILDLIFE

Folsom Reservoir

Increasing the flood storage space in Folsom Reservoir would have a significantly greater adverse impact on wildlife inhabiting and frequenting the area than on vegetation. The larger drawdown zone would (1) reduce aquatic vertebrate and invertebrate species which are food for wildlife, (2) expose many wildlife species to greater predation as they travel greater distance to seek food and water, and (3) eliminate existing wildlife habitat for small mammals, California quail, and other species that will not travel long distances to food and water.

Table 11. Lower American River Chinook Salmon Production (average annual under with-project conditions) 150 Year Protection*

	Without Project	With project	Difference
Escapement (spawners)	42,750	33,803	- 8,947
Harvest (catch)	135,090	106,817	-28,273
Oceam Commercial Catch	81,090	64,118	-16,972
Ocean Sport Catch	43,200	34,159	- 9,041
River Sport Catch	10,800	8,540	- 2,260

* With-project chinook salmon numbers based on 6/90 chinook salmon model indices with each alternative under 2020 level conditions as compared to baseline 2020 conditions.

Picivorous bird species such as mergansers, grebes, terns, gulls, and eagles would be impacted adversely by the reduction in fish population. Even if migration to adjacent areas were successful, most such areas would be at full carrying capacity and unable to support larger populations. These animals would be lost.

The large numbers of geese and ducks which annually winter on the expanse of open water at Folsom Reservoir would be adversely affected by reduced water levels. These species favor the backwater wetlands and sloughs in the upper arms which would be dewatered with the project. Open waters are becoming scarcer with rapid development of nearby areas.

Lake Natoma

Increasing the flood storage space in Folsom Reservoir would have no significant adverse impact on the wildlife of Lake Natoma. Conditions within Lake Natoma would essentially be the same as under without-project conditions.

Lower American River

Increasing floodway capacity in the lower American River would result in a loss of from 143 to 679 acres of wetland habitat, depending on the alternative considered. Because of the relatively high wildlife value of the habitat remaining in the area, any degradation or loss of habitat would be significant. The area is almost completely surrounded by developments, affording little room for relocation of displaced wildlife. Thus, those animals displaced would be lost.

In addition to construction impacts, the increase in flood storage capacity in Folsom Lake and the resultant reduction in releases downstream into the lower American River would reduce inundation of the active zone (point bars, eroding banks, and areas behind banks where early riparian succession occurs). Much of the area would slowly change from riparian forest, scrub-shrub, and emergent marsh to oak-grassland. Over the period of analysis, a significant conversion would occur; valuable wetland wildlife habitat would be lost.

DISCUSSION

Our recommendations are based on the Fish and Wildlife Service's Mitigation Policy (Federal Register 46:15, January 23, 1981) which provides internal guidance for establishing appropriate compensation for projects under our purview. Under this policy, resources are divided into four Resource Categories to assure that recommended mitigation is consistent with fish and wildlife values involved. The Resource Categories cover a range of habitat values from those considered to be unique and

irreplaceable to those believed to be of relatively low value to fish and wildlife. This policy does not apply to federally listed endangered or threatened species.

During impact assessment, specific habitat types that may be impacted by the project are identified, and evaluation species which utilize each habitat are selected. Selection of evaluation species can be based on several rationales including (1) species known to be sensitive to specific land and water use actions, (2) species that play a key role in nutrient cycling, or energy flow, (3) species that utilize a common environmental resource, or (4) species that are associated with Important Resource Problems as designated by the Director of the Fish and Wildlife Service, such as anadromous fish and migratory birds. Habitat value determinations are based on the importance of the habitat types found in the project area to the selected evaluation species and the relative scarcity of the habitat types.

The evaluation species selected to determine the Resource Category for aquatic habitat in Folsom Reservoir and Lake Natoma were warmwater gamefish, including largemouth and smallmouth bass, sunfish and catfish. These gamefish provide an important resource and recreational sport fishing opportunity for local anglers. However, aquatic habitat of this type is common throughout the region. Therefore, in accordance with the Mitigation Policy, we designated the aquatic habitat of Folsom Reservoir and Lake Natoma as Resource Category 3. Our mitigation goal under this category is no net loss of habitat value while minimizing loss of in-kind habitat value.

The evaluation species selected to determine the Resource Category for aquatic habitat in the lower American River included fall-run chinook salmon and steelhead trout. On a local basis and regional basis, these species are of the greatest commercial and sport fishing importance based on economic and recreational data. Although both salmon and steelhead populations in the lower American River are maintained largely by the Nimbus Salmon and Steelhead Hatchery program, there are significant numbers of naturally spawning salmon in the river. Our focus is to maintain habitat conditions for these naturally spawning stocks and to ensure that hatchery-produced stocks are effectively used. Since suitable habitat for chinook salmon spawning and rearing is diminishing and becoming scarce on a statewide basis, we designated the aquatic habitat of the lower American River as Resource Category 2. Our mitigation goal is no net-loss of in-kind habitat value.

Assessment of project impacts on chinook salmon and steelhead was based primarily on the flow vs. habitat information generated from our 1981 instream flow study (FWS, 1985). In addition, we relied on some of the water temperature criteria established for chinook salmon in the EDF vs. EBMUD litigation prepared for

Sacramento County (Leidy and Li 1987), and on criteria established for chinook salmon in the Bureau of Reclamation's Lower American River Water Contracting Draft EIS (USBR 1988).

The evaluation species selected to determine the Resource Category for wetlands of the lower American River were migratory waterfowl and other birds protected under the Migratory Bird Treaty Act, including great blue heron and wood duck. Other species selected for the wetlands assessment included black-shouldered kite, red-legged frog, muskrat, and mink. California's, and the Nation's, wetlands have been greatly diminished, are relatively scarce, and are of high value to the evaluation species. In accordance with the Mitigation Policy, we designated the wetlands as Resource Category 2. Our mitigation goal is no net loss of in-kind habitat value.

Evaluation species selected to determine the Resource Category for upland habitat were the short-eared owl, ring-necked pheasant, great blue heron, red-winged blackbird, gray squirrel, California quail, acorn woodpecker and western flycatcher.

Unlike the Natomas area, only a small portion of the lands within the lower American River floodway are under cultivation. Most of the upland is protected and remains in a natural condition. Although uplands are protected from development, grasslands along the levee berms and adjacent to the river are heavily impacted by public use. Nonetheless, these areas remain of moderate to high value for wildlife. Since uplands remain relatively abundant on a regional basis, we designated this habitat as Resource Category 3. Our mitigation goal is no net loss of habitat value while minimizing loss of in-kind value.

<u>150-YEAR PROTECTION (650,000 acre-feet storage; 180,000 cfs channel capacity)</u>

With respect to the lower American River segment of the American River Watershed Investigation, our analysis was concentrated on the 150-Year Protection alternative inasmuch as it would presumably be the logical next choice if neither the 200-Year Protection alternative nor the 400-Year Protection alternative were ultimately designated to be the selected plan. As previously noted, neither of the latter two alternatives would necessitate raising levees or other work along the lower American to increase the river's channel capacity.

<u>Folsom Reservoir</u>

Increased flood storage capacity in Folsom Reservoir would (1) further aggravate reservoir water level fluctuation, (2) reduce littoral rearing zone in the reservoir, and (3) virtually eliminate the coldwater pool in the reservoir in comparison to without-project conditions.

Maintaining a constant reservoir water level during the spawning season of warmwater fish species (April - June) would mitigate the adverse effects of water level fluctuation. A constant water level during this period would improve spawning success and significantly increase juvenile recruitment into the population.

With increased flood storage capacity, a reduction of rearing habitat in the littoral zone would occur with the lower reservoir water levels. To mitigate this loss, artificial shelters such as clumps of large trees and brush bundles chained and anchored to the reservoir bottom would be required. About 60 shelters should be located throughout the reservoir. The shelters should be placed at elevations within the reservoir that would not be dewatered with the evacuation of the flood storage pool. Construction, placement, and management of these shelters should be coordinated with the U. S. Fish and Wildlife Service, California Department of Fish and Game, and the California Department of Parks and Recreation. Cost to construct and place the shelters is estimated to be $600,000.

The reduced coldwater pool in the reservoir with increased flood storage would severely impact the coldwater trout fishery of the reservoir. The fishery that would be lost is the larger trout that over-summer in the cool waters of the reservoir and become available for angler harvest in the late summer and fall. To mitigate the loss of this fishery, planting of catchable-size rainbow trout should be increased in the winter and spring months. With planting, average annual angler-use would equal the without-project level of 120,000 days. Arrangement can be made with the California Department of Fish and Game or a private contractor to acquire 30,000 catchable-size rainbow trout (1/2 pounders). Estimated cost for rainbow trout is $27,000 annually (15,000 lbs. at $1.79/lb.).

<u>Lower American River</u>

With the increase of flood storage capacity in Folsom Reservoir, downstream flows and water temperature problems would be exacerbated over without-project conditions. Decreased flows and increased water temperatures in low water years over the life of the project, especially during the critical peak spawning month of November, would virtually eliminate natural spawning of chinook salmon in the lower river. To mitigate this loss, adequate storage should be carried over in Folsom Reservoir from the spring/summer period to ensure a sustained minimum release schedule as follows:

Period	Water Year: Wet, Above-Normal, or Below Normal	Water Year: Dry, or Critically Dry
October-December 31	1750 cfs	1250 cfs
January-June 30	1250 cfs	1250 cfs

Flow released to reach the above minima should not begin until daily water temperature measured at Nimbus Dam is suitable for spawning (56 F. or lower). Although further increases are acceptable, no significant reduction should occur during the spawning period or egg incubation period.

In addition, if water temperature does not drop to 56°F. by November 30, the power turbines should be bypassed and lower level water releases made to provide a cooler water temperature. This should continue until ambient temperature falls to 56°F.

To mitigate for an increase in April temperature, during the salmon rearing and smolt emigration period, block of water of 60,000 acre-feet should be set aside in reservoir storage for discretionary use by the California Department of Fish and Game for water temperature control for fish emigration purposes during the spring/summer period.

To mitigate the loss of spawning gravels that would occur with increased flood flows (115,000 to 180,000 cfs), we recommend that suitable gravels (1/2 to 3 inch diameter) be placed (during summer) at Sailor Bar whenever downstream releases have exceeded 115,000 cfs. Although the amount of gravel loss has not been precisely quantified at this time, we believe the placement of 4,500 cubic yards would be sufficient to mitigate this loss. Estimated cost to purchase and place the gravel is $70,000. Monitoring would be required to determine replacement needs. Annual cost of monitoring would be $5,000. Placement site or sites should be coordinated with the U.S. Fish and Wildlife Service and the California Department of Fish and Game.

Implementation of the preceding measures would provide sufficient suitable habitat to maintain existing levels of naturally spawning chinook salmon, sport ocean and freshwater catches, and the commercial harvest.

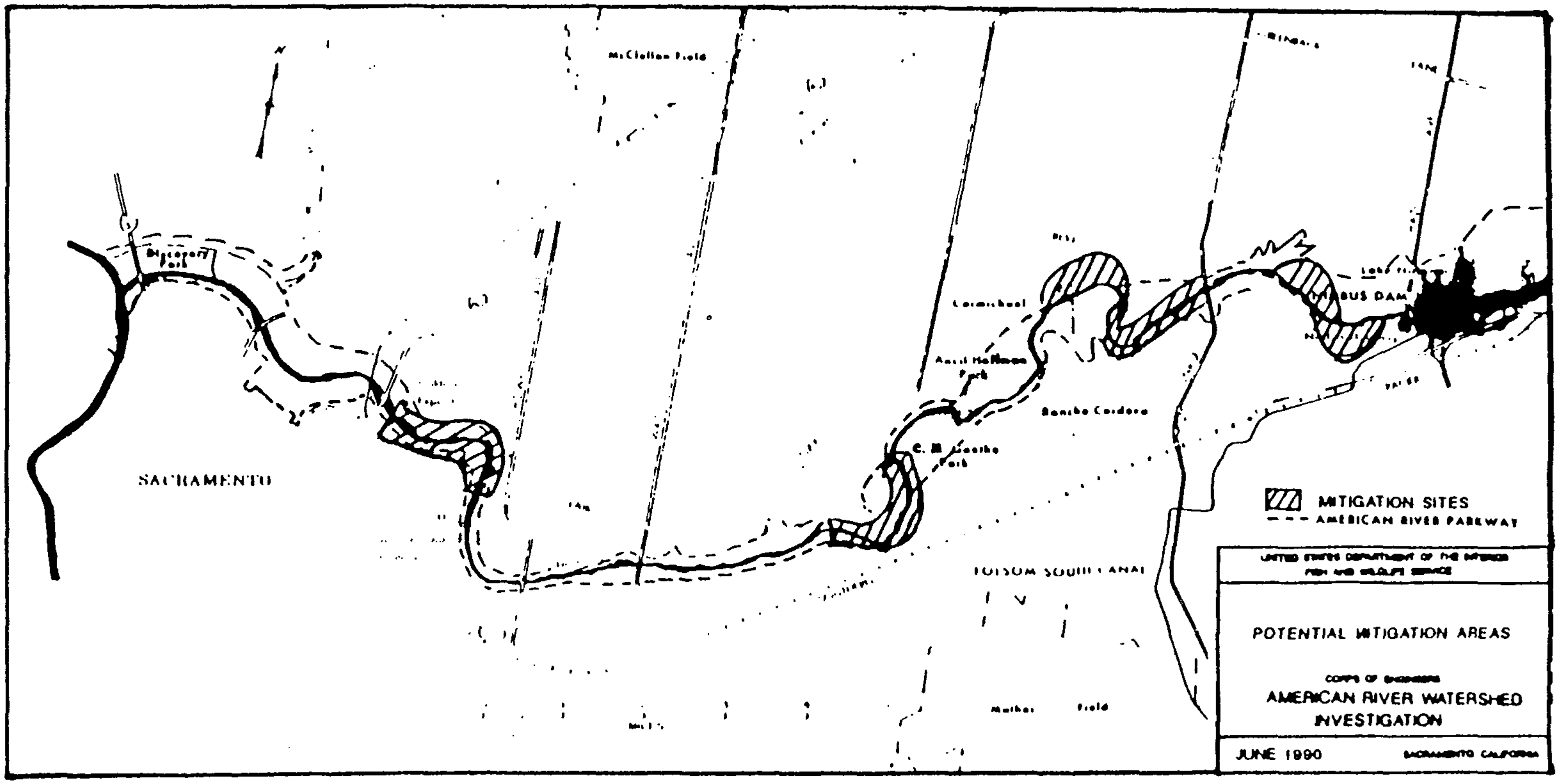
As stated in the with-project section, there would be a net loss in wetland acreage and habitat value due to conversion of riparian forest, emergent marsh and open water to upland habitat (grassland and oak woodland). To mitigate net loss or degradation of 679 acres of wetlands due to (1) the construction impacts of increasing the flood flow capacity of the lower American River from 115,000 cfs to 180,000 cfs, and (2) reduced stream flow in this reach of the river with enlargement of the

flood storage pool at Folsom Reservoir, 1,439 acres in the lower American River floodway would be needed for management as a wetland/upland complex. Potential sites for mitigation are identified in Figures 24, 25 and 26. (The mitigation need for the other alternatives affecting the lower American River are: 100-Year (FEMA) Levees--979 acres; 100-Year (FEMA) Levees/Storage--962 acres; and 100-Year (FEMA) Storage--303 acres.)

Management measures would require (1) the excavation and contouring of lands to achieve open water, emergent marsh, riparian forest, and upland habitats, (2) an adequate year-round supply of good quality water to maintain at least 25 percent of the area in open water, (3) soils and other site features suitable to support cover types in the following ratios: 28% emergent marsh, 25% open water, 40% palustrine forest, and 7% palustrine scrub-shrub, (4) replanting with native species, (5) watering of riparian and upland plantings, preferably by drip irrigation, for a minimum of 6 years, or until well established, and (6) monitoring for a period of at least 20 years beyond the initial establishment period.

Excluding land acquisition and excavation, we estimate a cost of $25,000 per acre for such a plan. Average annual replacement, maintenance and operation cost and monitoring cost, are estimated at $24,000 and $11,000, respectively. A permanent source of water would be needed to supply the open water portion of the wetland/upland complex.

All phases of the mitigation planting plan should be coordinated with the Fish and Wildlife Service, California Department of Fish and Game, Sacramento County Parks and Recreation Department, and the American River Flood Control District. Any private lands (within the floodway) acquired to meet mitigation needs should be incorporated into the American River Parkway. Management of the mitigation area(s) should be by the Sacramento County Parks and Recreation Department exclusively for wildlife.



FROM BUREAU OF RECLAMATION MAP

FIGURE 24

FIGURE 25. SACRAMENTO BAR MITIGATION SITE

FIGURE 26 SACRAMENTO BAR MITIGATION SITE

RECOMMENDATIONS

For the 150-year alternative, the Fish and Wildlife Service recommends that:

Folsom Reservoir

1. Water levels at Folsom Reservoir be stabilized during the warmwater fish spawning season (April-June) to improve spawning success.

2. Artificial shelters such as clumps of large trees and brush bundles be chained and anchored to the bottom of Folsom Reservoir to provide fish rearing habitat. Cost to construct and place shelters is estimated at $600,000. All phases of construction, placement and management should be coordinated with the Fish and Wildlife Service, California Department of Fish and Game, and the California Department of Parks and Recreation.

3. To mitigate the loss of the coldwater trout fishery, 30,000 rainbow trout (1/2 pounders) be planted in Folsom Reservoir during the winter and spring months. Annual cost is estimated at $27,000. This is in addition to plantings presently conducted annually by the California Department of Fish and Game.

Lower American River

4. To mitigate the adverse impacts of the project on naturally spawning chinook salmon (critical period November), the following minimum flows be provided:

	Water Year	
Period	Wet, Above-Normal, or Below Normal	Dry or Critically Dry
October-December 31	1750 cfs	1250 cfs
January-June 30	1250 cfs	1250 cfs

Details regarding water temperature, timing, and alternative measure to meet temperature requirements are as provided in the Discussion Section.

5. To provide adequate water temperature for salmon rearing and smolt emigration (spring-summer), a block of water (60,000 acre-feet) be reserved in Folsom Reservoir for discretionary release by the Department of Fish and Game.

6. To mitigate the loss of spawning gravels, 4,500 cubic yards of gravels (1/2 to 3 inch diameter) be placed at Sailor Bar

whenever downstream water releases have exceeded 115,000 cfs. Estimated cost to purchase and place gravels is $70,000. Monitoring will be required to determine replacement needs at an estimated cost of $5,000. Final placement site or sites should be coordinated with the Fish and Wildlife Service and the California Department of Fish and Game.

7. To mitigate the loss of wildlife habitat values in the lower American River, 1,459 acres of land in the lower American River floodway be acquired and developed for management as a wetland/upland complex. Details for planting the area with appropriate species appear in the Discussion Section. Estimated cost to implement the planting plan is $35,250,000. Average annual replacement, maintenance and operation cost, and monitoring cost are $24,000 and 11,000, respectively.

All phases of the mitigation planting plan should be coordinated with the Fish and Wildlife Service, California Department of Fish and Game, Sacramento County Parks and Recreation Department, and the American River Flood Control District.

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APPENDIX A

FISH FREQUENTING THE LOWER AMERICAN RIVER

	STATUS
ANADROMOUS GAME FISH	
Chinook (king) salmon	Numerous in fall
Coho (silver) salmon	Occasional
Pink salmon	Rare
Chum salmon	Rare
White sturgeon	Uncommon
Striped bass*	Numerous in summer
American shad*	Numerous in spring
Steelhead rainbow trout	Numerous
COLDWATER GAME FISH	
Kokanee*	Strays downstream from Nimbus
Rainbow trout	Numerous
Brown trout*	Rare
WARMWATER GAME FISH	
Largemouth bass*	Common in backwaters
Smallmouth bass*	Common in backwaters
Green sunfish*	Common in backwaters
Bluegill	Common in backwaters
Redear sunfish*	Few in backwaters
White crappie*	Few in backwaters
Sacramento perch	Rare
Channel catfish*	Uncommon
White catfish*	Common in backwaters
Brown bullhead*	Few in backwaters
Black bullhead*	Few in backwaters
NONGAME FISH	
Sacramento sucker	Numerous
Carp*	Numerous
Goldfish	Numerous
Sacramento blackfish	Uncommon
Hardhead	Occasional
Sacramento hitch	Occasional
Sacramento squawfish	Numerous
Splittail	Occasional
Mosquitofish*	Numerous in backwaters
Tule perch	Numerous
Riffle sculpin	Numerous
Pacific lamprey	Common and anadromou
Threadfin shad*	Occasional
Golden shiner*	Present above Nimbus
Fathead minnow*	Present above Nimbus
Thicktail chub	Very rare (possibly extinct)
Western roach	Uncommon
Sacramento tui chub	Uncommon
Speckled dace	Uncommon

*Introduced Species

SOURCE: GERSTUNG, 1971

The Scientific and Common Names of Plant Species Discussed in the Text

Common Names	Scientific Names	Area of Occurrence[1] Nat.	L Am.	Aub.
Alkali bulrush	_Scirpus olneyi_	X	X	
Alkali heath	_Frankenis grandiflora_ var. _campestris_	X		
Alkali weed	_Cressa truxellensis_	X	X	
Asparagus	_Asparagus_ sp.	X	X	X
Baltic rush	_Juncus balticus_	X	X	X
Bigleaf maple	_Acer macrophyllum_		X	X
Blackberry	_Rubus procerus_	X	X	X
Black oak	_Quercus kelloggii_			X
Black sage	_Salvia mellifera_		X	X
Bladderwort	_Utricularia_ sp.	X	X	X
Blue oak	_Quercus douglasii_	X	X	X
Blue wild rye	_Elymus glaucus_	X	X	X
Boisduvalia	_Boisduvalia_ sp.	X	X	
Boxelder	_Acer negundo_ ssp. _californicum_	X	X	X
Brome	_Bromus_ sp.	X	X	X
Brass buttons	_Cotula coronopifolia_	X	X	
Brodiaea	_Brodiaea Dichelostemma_ and _Triteleia_ sp.	X	X	X
Buckrush	_Ceanothus cuneatus_		X	X
Buckeye	_Aesculus californica_		X	X
Buckwheat	_Eriogonum_ sp.	X	X	X
Bulrush	_Scirpus acutus_	X	X	
Burrow bush	_Hymenochlea salsola_	X	X	
Busk monkeyflower	_Displacus aurantiacus_		X	X
Buttonwillow	_Cephalanthus occidentalis_	X	X	X
California bay	_Umbellularia californica_		X	X
California melic	_Melica californica_	X	X	X
California sagebrush	_Artemisia californica_	X	X	X
Canyon live oak	_Quercus chrysolepis_	X	X	X
Cat's ear	_Hypochoeris glabra_	X	X	X
Cattails	_Typha latifolia_ and _T. angustifolia_	X	X	X
Chain fern	_Woodwardia fimbriata_		X	X
Chamise	_Adenostoma fasciculatum_			X
Clematis	_Clematis_ sp.	X	X	X
Clover	_Trifolium_ sp.	X	X	X
Cocklebur	_Xanthium strumarium_ var. _canadense_	X	X	X
Coffeeberry	_Rhamnus californicus_ ssp. _tomentella_	X	X	X

[1] Nat. = Natomas, L. Am = Lower American, Aub. = Auburn

(cont.)

		Area of Occurrence		
		Nat.	L. Am	Aub.
Common reed grass	Phragmites communis	X	X	
Cottonwood	Populus fremontii	X	X	X
Creek dogwood	cornus stolonifera		X	X
Digger pine	Pinus sabiniana		X	X
Douglas-fir	Pseudotsuga menziesii			X
Downingia	Downingia sp.	X	X	
Duckweed	Lemna minor	X	X	X
Elderberry	Sambucus spp.	X	X	X
Elodea	Elodea canadensis	X	X	X
Fat hen	Atriplex patula	X	X	X
Fescue	Festuca spp.	X	X	X
Fiddleneck	Amsinckia spp.	X	X	X
Filaree	Erodium spp.	X	X	X
Flannel bush	Fremontodendron californicum			X
Fleshy jaumea	Jaumea carnosa	X	X	
Flowering dogwood	Cornus nuttallii			X
Foxtail	Hordeum spp.	X	X	X
Giant reed	Arundo donax	X	X	
Goldfields	Lasthenia californica	X	X	
Gooseberry	Ribes sp.		X	X
Hairgrass	Deschampsia danthonioides	X	X	X
Hazelnut	Corylus cornuta var. californica			X
Horned pondweed	Zanichellia palustris	X	X	
Horsetail	Equisetum spp.	X	X	X
Horseweed	Conyza canadensis	X	X	X
Incense cedar	Calocedrus decurrens			X
Interior live oak	Quercus wislizenii		X	X
Iodine bush	Allenrolfea occidentalis	X		
Knit grass	Gastridium ventricosum	X	X	X
Lady fern	Athyrium filix-femina		X	X
Barley	Hordeum spp.	X	X	X
Lupine	Lupinus spp.	X	X	X
Manzanita	Arctostaphylos spp.		X	X
Grindelia	Grindelia spp.	X	X	X
Marsh pennywort	Hydrocotyle verticillata	X	X	
Meadowfoam	Limnanthes sp.	X	X	X
Mistletoe	Phoradendron sp.	X	X	X
Mountain mahogany	Cercocarpus betuloides		X	X
Mousetail	Myosurus minimus	X		
Mugwort	Artemisia douglasiana	X	X	X
Mulefat	Baccharis viminea	X	X	X
Mustard	Brassica	X	X	X
Navarretia	Navarretia sp.	X	X	X
Nettles	Urtica sp.	X	X	X
Needlegrass	Stipa spp.	X	X	X
Oregon ash	Fraxinus latifolia	X	X	X
Owl's clover	Orthocarpus spp.	X	X	X
Pepper grass	Lepidium sp.	X	X	X
Pickleweed	Salicornia sp.	X		

(cont.)

		Area of Occurrenc		
		Nat.	L. Am	Aub.
Pogogyne	Pogogyne douglasii	X	X	
Poison-oak	Toxicodendron diversilobum	X	X	
Ponderosa pine	Pinus ponderosa			X
Pondweed	Potamogeton sp.	X	X	X
Popcorn flower	Plagiobothrys sp.	X	X	X
Poppy	Eschscholzia californica	X	X	X
Redbud	Cercis occidentalis		X	X
Rush	Juncus sp.	X	X	X
Salt grass	Distichlis spicata	X	X	
Sand-spurry	Spergularia sp.	X	X	
Sedge	Carex sp.	X	X	X
Seep-weed	Suaeda spp.	X		
Serviceberry	Amelanchier sp.			X
Snowberry	Symphoricarpos sp.			X
Spice bush	Calycanthus occidentalis			X
Spike rush	Eleocharis macrostachya	X	X	X
Saltbush	Atriplex spp.	X	X	X
Sugar pine	Pinus lambertiana			X
Sycamore	Platanus racemosa	X	X	X
Tanoak	Lithocarpus densiflora			X
Thistle	Silybum marianum	X	X	X
Toyon	Heteromeles arbutifolia		X	X
Tule	Scirpus sp.	X	X	X
Umbrella sedge	Cyperus eragrostis	X	X	X
Valley oak	Quercus lobata	X	X	X
Valley saltbush	Atriplex polycarpa	X	X	
Verbena	Verbena spp.	X	X	
Walnut	Juglans spp.	X	X	
Water fern	Azolla filiculoides	X	X	X
Water lily	Nuphar polysepalum	X	X	X
Water milfoil	Myriophyllum sp.	X	X	X
White alder	Alnus rhombifolia	X	X	X
White fir	Abies concolor			X
White thorn	Ceanothus cordulatus			X
Wild grape	Vitis californica	X	X	X
Wild oats	Avena spp.	X	X	X
Wild rose	Rosa californica	X	X	X
Willow	Salix sp.	X	X	X
Woolly marbles	Psilocarphus brevissimus	X	X	
Yellow waterweed	Ludwigia peploides	-	X	

Table A. Wildlife Species of the American River Watershed Study Area

Common Name	Scientific Name	Habitats[a]
	BIRDS	
Red-throated loon	Gavia stellata	O
Common loon	Gavia immer	O
Pied-billed grebe	Podilymbus podiceps	O,M
Horned grebe	Podiceps auritus	O,M
Eared grebe	Pidiceps nigricollis	O,M
Western grebe	Aechmophorus occidentalis	O
American white pelican	Pelecanus erythrorhynchos	O,M
Double-crested cormorant	Phalacrocorax auritus	O,M
American bittern	Botaurus lentiginosus	M
Great blue heron	Ardea herodias	M,R
Great egret	Casmerodius albus	M,R
Snowy egret	Egretta thula	M
Cattle egret	Bubulcus ibis	M,A
Green-backed heron	Butorides striatus	M,R
Black-crowned night heron	Nycticorax nycticorax	M,R
White-faced ibis	Plegadis chihi	M,A
Tundra swan	Cygnus columbianus	M,A
Greater white-fronted goose	Anser albifrons	M,A
Snow goose	Chen caerulescens	M,A
Ross' goose	Chen rossii	M,A
Canada goose	Branta canadensis	M,A,C
Wood duck	Aix sponsa	M,R
Green-winged teal	Anas crecca	M,O
Mallard	Anas platyrhynchos	M,O
Norther Pintail	Anas acuta	M,O
Blue-winged teal	Anas discors	M,O
Cinnamon teal	Anas cyanoptera	M,O
Northern shoveler	Anas clypeata	M,O
Gadwall	Anas strepera	M,O
Eurasian wigeon	Anas penelope	M,O
American wigeon	Anas americana	M,O
Canvasback	Aythya valisineria	M,O
Redhead	Aythya americana	M,O
Ring-necked duck	Aythya collaris	M,O
Greater scaup	Aythya marila	M,O
Lesser scaup	Aythya affinis	M,O
Common goldeneye	Bucephala clangula	M,O
Barrow's goldeneye	Bucephala islandica	M,O
Bufflehead	Bucephala albeola	M,O
Hooded merganser	Lophodytes cucullatus	M,O
Common merganser	Mergus merganser	O
Ruddy duck	Oxyura jamaicensis	M,O

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Turkey vulture	Cathartes aura	C,W,A,F
Osprey	Pandion haliaetus	O
Black-kshouldered kite	Elanus caeruleus	C,W,A
Bald eagle	Haliaeetus leucocephalus	O
Northern harrier	Circus cyaneus	A,G,M
Sharp-shinned hawk	Accipiter striatus	W,G,R,F
Cooper's hawk	Accipiter cooperii	W,G,R,F
Northern goshawk	Accipiter gentilis	W,G,F
Red-shouldered hawk	Buteo lineatus	R
Swainson's hawk	Buteo swainsoni	A,R,G
Red-tailed hawk	Buteo jamaicensis	A,R,G,W,C,F
Ferruginous hawk	Buteo regalis	A,G
Rough-legged hawk	Buteo lagopus	A,G
Golden eagle	Aquila chrysaetos	G,W
American kestrel	Falco sparverius	A,G,R,F
Merlin	Falco columbarius	A,G
Peregrine falcon	Falco peregrinus	M,A,G,F
Prairie falcon	Falco mexicanus	G,A,M
Ring-necked pheasant	Phasianus colchicus	A,R
Wild turkey	Meleagris gallopavo	G,W,F
California quail	Callipepla californica	O,W,C,R,F
Mountain quail	Oreortyx pictus	W,C,F
Virginia rail	Rallus limicola	M
Sora	Porzana carolina	M
Common moorhen	Gallinula chloropus	M,O
American coot	Fulica americana	M,O
Sandhill crane	Grus canadensis	A,M
Black-bellied plover	Pluvialis squatarola	G,M,A
Lesser golden plover	Pluvialis dominica	G,M,A
Snowy plover	Charadrius alexandrinus	M
Semipalmated plover	Charadrius semipalmatus	M
Killdeer	Charadrius vociferus	M,A,G
Mountain plover	Charadrius montanus	A
Black-necked stilt	Himantopus mexicanus	M,A
American avocet	Recurvirostra americana	M,A
Greater yellowlegs	Tringa melanoleuca	M
Lesser yellowlegs	Tringa flavipes	M
Solitary sandpiper	Tringa solitaria	M
Willet	Catoptrophorus semipalmatus	M
Spotted sandpiper	Actitis macularia	M,R
Whimbrel	Numenius phaeopus	M
Long-billed curlew	Numenius americanus	M,A,C

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Marbled godwit	Limosa fedoa	M
Red knot	Calidris canutus	M
Western sandpiper	Calidris mauri	M
Least sandpiper	Calidris minutilla	M
Baird's sandpiper	Calidris bairdii	M
Pectoral sandpiper	Calidris melanotos	M
Dunlin	Calidris alpina	M
Short-billed dowitcher	Limnodromus griseus	M
Long-billed dowitcher	Limnodromus scolopaceus	M
Common snipe	Gallinago gallinago	M
Wilson's phalarope	Phalaropus tricolor	M,O
Red-necked phalarope	Phalaropus lobatus	M,O
Bonaparte's gull	Larus philadelphia	M,O
Mew gull	Larus canus	M,O
Ring-billed gull	Larus delawarensis	M,O,A
California gull	Larus californicus	M,O,A
Herring gull	Larus argentatus	M,O,A
Thayer's gull	Larus thayeri	M,O,A
Glaucous-winged gull	Larus glaucescens	M,O,A
Caspian tern	Sterna caspia	O
Forster's tern	Sterna forsteri	O
Black tern	Chlidonias niger	M,O
Rock dove	Columba livia	G,A
Band-tailed pigeon	Columba fasciata	W,C,F
Mourning dove	Zenaida macroura	A,W,C,G,F
Yellow-billed cuckoo	Coccyzus americanus	R
Greater roadrunner	Geococcyx californianus	C
Common barn-owl	Tyto alba	A,G
Western screech-owl	Otus kennicottii	W,R,F
Great horned owl	Bubo virginianus	W,R,F
Northern pygmy-owl	Glaucidium gnoma	W
Burrowing owl	Athene cunicularia	G,A
Long-eared owl	Asio otus	R
Short-eared owl	Asio flammeus	O,A,M
Northern saw-whet owl	Aegolius acadicus	W,F
California spotted owl	Strix occidentalis	W,F
Lesser nighthawk	Chordeiles acutipennis	C,R,F
Common nighthawk	Chordeiles minor	C,R,F
Common poorwill	Phalaenoptilus nuttallii	C,R
Vaux's swift	Chaetura vauxi	R,C,F
White-throated swift	Aeronautes saxatalis	R,C,W,F
Black-chinned hummingbird	Archilochus alexandri	R,C
Anna's hummingbird	Calypte anna	R,C,U,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (CONTINUED)	
Costa's hummingbird	Calypte costae	R,C
Rufous hummingbird	Selasphorus rufus	R,U
Allen's hummingbird	Sleasphorus sasin	R,U
Belted kingfisher	Ceryle alcyon	R,O
Lewis' woodpecker	Melanerpes lewis	W,G,F
Acorn woodpecker	Melanerpes formicivorous	W,G,F
Yellow-bellied sapsucker	Sphyrapicus varius	W,R,A
Red-breasted sapsucker	Sphyrapicus ruber	W,R,F
Nuttall's woodpecker	Picoides nuttallii	W,R,F
Downy woodpecker	Picoides pubescens	W,R,F
Hairy woodpecker	Picoides villosus	W,F
Northern flicker	Colaptes auratus	W,R,G,F
Olive-sided flycatcher	Contopus borealis	W,R,F
Western wood-pewee	Contopus sordidulus	W,R,F
Willow flycatcher	Empidonax traillii	R
Hammond's flycatcher	Empidonax hammondii	R,W,F
Dusky flycatcher	Empidonax oberholseri	R,W,C,F
Gray flycatcher	Empidonax wrightii	R
Western flycatcher	Empidonax difficilis	R,F
Black phoebe	Sayornis nigricans	R,M
Say's phoebe	Sayornis saya	G
Ash-throated flycatcher	Myiarchus cinerascens	W,R
Western kingbird	Tyrannus verticalis	G
Horned lark	Eremophila alpestris	G
Purple martin	Progne subis	G
Tree swallow	Tachycineta bicolor	R,A,G,F
Violet-green swallow	Tachycineta thalassina	R,A,G,F
Northern rough-winged swallow	Stelgidopteryx serripennis	R,A,G
Bank swallow	Riparia riparia	R
Cliff swallow	Hirundo pyrrhonota	R,A,G,O
Barn swallow	Hirundo rustica	R,A,G,O
Scrub jay	Aphelocoma coerulescens	W,R,F
Yellow-billed magpie	Pica nuttalli	G,R
American crow	Corvus brachyrhynchos	W,G,R
Plain titmouse	Parus inornatus	W,R,F
Bushtit	Psaltriparus minumus	W,R,F
Red-breasted nuthatch	Sitta canadensis	W,F
White-breasted nuthatch	Sitta carolinensis	W,F
Brown Creeper	Certhia americana	W,F
Rock wren	Salpinctes obsoletus	Ro
Canyon wren	Catherpes mexicanus	Ro
Bewick's wren	Thryomanes bewickii	R,W,C,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
House wren	Troglodytes aedon	R,W,F
Winter wren	Troglodytes troglodytes	R
Marsh wren	Cistothorus palustris	M
American dipper	Cinclus mexicanus	R
Golden-crowned kinglet	Regulus satrapa	W,R,F
Ruby-crowned kinglet	Regulus calendula	W,R,F
Blue-gray gnatcatcher	Polioptila caerulea	R,C,F
Western bluebird	Sialia mexicana	G,W,C
Mountain bluebird	Sialia currucoides	G,W
Townsend's solitaire	Myadestes townsendi	W,F
Swainson's thrush	Catharus ustulatus	R,W,F
Hermit thrush	Catharus guttatus	R,W,C,F
American robin	Turdus migratorius	G,R,W,C,U,
Varied thrush	Ixoreus naevius	R,W,F
Wrentit	Chamaea fasciata	R,C
Northern mockingbird	Mimus polyglottos	R,C,U
California thrasher	Toxostoma redivivum	C,R
Water pipit	Anthus spinoletta	G
Cedar waxwing	Bombycilla cedrorum	W,F
Phainopepla	Phainopepla nitens	R,W,F
Loggerhead shrike	Lanius ludovicianus	G,A
European starling	Sturnus vulgaris	G,A,U,W,C
Solitary vireo	Vireo solitarius	W,R,F
Hutton's vireo	Vireo huttoni	W,R,F
Warbling vireo	Vireo gilvus	W,R,F
Orange-crowned warbler	Vermivora celata	C,R,W,F
Nashville warbler	Vermivora ruficapilla	R,W,F
Yellow warbler	Dendroica petechia	R,F
Yellow-rumped warbler	Dendroica coronata	R,W,U,F
Black-throated gray warbler	Dendroica nigrescens	W,F
Townsend's warbler	Dendroica townsendi	W,F
Hermit warbler	Dendroica occidentalis	W,F
MacGillivray's warbler	Oporornis tolmiei	W,R,F
Common yellowthroat	Geothlypis trichas	M,R
Wilson's warbler	Wilsonia pusilla	M,r,C,F
Yellow-breasted chat	Icteria virens	R
Western tanager	Piranga ludoviciana	W,R,F
Black-headed grosbeak	Pheucticus melanocephalus	W,R
Blue grosbeak	Guiraca caerulea	R,G
Lazuli bunting	Passerina amoena	R,G,W,F
Rufous-sided towhee	Pipilo erythrophthalmus	C,U,F
Brown towhee	Pipilo fuscus	C,U,F
Rufous-crowned sparrow	Aimophila ruficeps	C,R
Chipping sparrow	Spizella passerina	C,R,W,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Vesper sparrow	Pooecetes gramineus	G
Lark sparrow	Chondestes grammacus	G,W
Sage sparrow	Amphispiza belli	C
Savannah sparrow	Passerculus sandwichensis	G,R
Fox sparrow	Passerella iliaca	R,C,F
Song sparrow	Melospiza melodia	R,M
Lincoln's sparrow	Melospiza lincolnii	R,M
Golden-crowned sparrow	Zonotrichia atricapilla	G,U,C
White-crowned sparrow	Zonotrichia leucophrys	G,U,C
Dark-eyed junco	Junco hyemalis	G,W,C,
Red-winged blackbird	Agelaius phoeniceus	M,R,G,
Tricolored blackbird	Agelaius tricolor	M,R,G,
Western meadowlark	Sturnella neglecta	G,F
Yellow-headed blackbird	Xankthocephalus xanthocephalus	M
Brewer's blackbird	Euphagus cyanocephalus	M,A,U,
Brown-headed cowbird	Molothrus ater	R,M,G,
Northern Oriole	Icterus galbula	W,F
Purple finch	Carpodacus purpureus	R,W,F
House finch	Carpodacus mexicanus	R,W,A,U,
Pine siskin	Carduelis pinus	W,F
Lesser goldfinch	Carduelis psaltria	R,G,W,
Lawrence's goldfinch	Carduelis lawrencei	R,G,W,C,
American goldfinch	Carduelis tristis	R,G,W,C,
Evening grosbeak	Coccothraustes vespertinus	W,F
House sparrow	Passer domesticus	U
	AMPHIBIANS	
Foothill Yellow legged frog	Rana boylei	R,M,F
California newt	Taricha torosa	R,G,W,
Tiger salamander	Ambystoma tigrinum	R,G
California slender salamander	Batrachoseps attenuatus	R,G,W
Arboreal salamander	Aneides lugubris	W
Western spadefoot	Scaphiopus hammondi	G
Western toad	Bufo boreas	R,G
Pacific treefrog	Hyla regilla	R,G
Bullfrog	Rana catesbeiana	M
Ensatina	Ensatina eschschottzi	R,W,M,

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	REPTILES	
Western pond turtle	Clemmys marmorata	M,R,F
Western fence lizard	Sceloporus occidentalis	C,W,G,I
Gilbert's skink	Eumeres gilberti	G,W,Rc
Western skink	Eumeres skiltonianus	G,W,Ro
Western whiptail	Cnemidophorus tigris	W,R
Southern alligator lizard	Gerrhonotus multicarinatus	G,C,W,I
Ringneck snake	Diadophis punctatus	W,G,C,F
Sharp-tailed snake	Contia tenuis	W,G,C,F
Coachwhip	Masticophis flagellum	G,W
Racer	Coluber constrictor	C,G,F
Gopher snake	Pituophis melaneoleucuc	G,W,R,M,A
Common kingsnake	Lampropeltis getulus	G,W,R,M,
Long-nosed snake	Rhinocheilus lecontei	G,W
Giant garter snake	Thamnophis gigas	M,R,O,W
Common garter snake	Thamnophis sirtalis	A,M,G
Western terrestrial garter snake	Thamnophis elegans	M,G,F
Western aquatic garter snake	Thamnophis couchi	M,G,O,F
Night snake	Hypsiglena torquata	C,R
Western rattlesnake	Crotalus virdis	C,G,R,W,
Coast horned lizard	Phrynosoma coronatum	G,Ro,W,C
	MAMMALS	
Trowbridge shrew	Sorex trowbridgei	R,W
Virginia opossum	Didelphis virginiana	R,F
Vagrant shrew	Sorex vagrans	R,G,M
Ornate shrew	Sorex ornatus	R,M
California myotis	Myotis californicus	Widespread in ma habitat
Red bat	Lasiurus borealis	Widespread in ma habitat
Hoary bat	Lasiurus cinereus	Widespread in ma habitat
Pallid bat	Antrozous pallidus	Widespread in ma habitat
Brazilian free-tailed bat	Tadarida brasiliensis	Widespread in ma habitat
Big free-tailed bat	Tadarida macrotis	Widespread in ma habitat
Desert cottontail	Sylvilagus audubonii	G,M,R
Brush rabbit	Sylvilagus bachmani	C,W,R
Broad-footed mole	Scapanus latimanus	G,W,A
Yuma myotis	Myotis yumanensis	Widespread in ma habitat

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	MAMMALS (continued)	
Western pipistrelle	Pipistrellus hesperus	Widespread in ma habitat
Big Brown Bat	Eptesicus fuscus	Widespread in ma habitat
Townsends big-caved bat	Plecotus townsendi	Widespread in ma habitat
Black-tailed hare	Lepus californicus	G,M
California ground squirrel	Spermophilus beechevi	G,M,R,C
Beaver	Castor canadensis	R,M,F
Western harvest mouse	Reithrodontomys megalotis	G
Deer mouse	Peromyscus maniculatus	G,F
California vole	Microtus californicus	G,F
Muskrat	Ondatra zibethicus	M,F
Black rat	Rattus rattus	U,A,F
Norway rat	Rattus norvegicus	U,A,F
House mouse	Mus musculus	U,A,F
Coyote	Canis latrans	C,W,G,F
Red Fox	Vulpes vulpes	G,W,F
Gray fox	Urocvon cinereoargenteus	G,W,R,F
Ringtail	Bassariscus astutus	R,F
Raccoon	Procvon lotor	R,F
Mink	Mustela vison	R,M,F
Western spotted skunk	Spilogale gracilis	R
Striped skunk	Mephitis mephitis	R,W
River otter	Lutra canadensis	R
Black-tailed deer	Odocoileus hemionus	C,W,G,R,F
Western gray squirrel	Sciurus griseus	W,R,F
Botta's pocket gopher	Thomomy's bottae	R,G,W
Brush mouse	Peromyscus boylei	C,W,F
Pinyon mouse	Peromyscus truei	W,Ro,F
Dusky-footed woodrat	Neotoma fuscipes	C,W,R,F
Porcupine	Erethizon dorsatum	C,F
Long-tailed weasel	Mustela frenata	Widespread in ma habitat
Badger	Taxidea taxus	G,A,W
Mountain lion	Felis concolor	R,W,C,Ro,F
Bob cat	Lynx rufus	R,G,W,C,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

APPENDIX B

Lower American River
Salmon Habitat Index Model

The model is based on information developed in the Service's 1981 lower American River Instream Flow Study (FWS 1985), information developed by Jo and Stokes Associates, Inc., for the U.S. Bureau of Reclamation's 1988 dra environmental impact statement on the American River Service Area Water Contracting Program, information developed in the lower American River EDF al vs. EBMUD court reference (Leidy and Li 1987) and other Service field studies on the lower American River.

The usefulness of the model is limited. It was developed for comparing alternative flow regimes in terms of salmon habitat conditions. The model calculates an overall habitat index which is based on fall, winter and spr flow and water temperature criteria. The indices do not reflect actual sal population numbers but only relative numbers and gross trends. At this tin do not believe there is adequate information to develop criteria for a mode that would accurately predict population numbers.

The model includes means to assess flows and water temperatures for fall spawning conditions, juvenile winter and spring rearing conditions and spr emigration of salmon smolts. It does not account for Delta or ocean rearir phases of the salmon life cycle.

Chinook Salmon Habitat Index Model

Assumptions (Partial Listing)

1. The model is intended to make relative comparisons between different reservoir operation alternatives with respect to salmon habitat and survival on the lower American River.

2. The model does not address impacts on the salmon fishery outside the lower American River.

3. Model indices do not represent any official position on flows or temperature criteria for the lower American River.

4. The model is for natural spawning fall-run chinook salmon only and dc not account for any Nimbus Salmon and Steelhead Hatchery contributio

5. The model does not compute an index greater than 1.00.

6. Flow indices of 1.00 in the fall, winter and spring represent optima near optimal conditions based on information gathered on our 1981 instream flow study (FWS, 1985) and other available information.

7. temperature indices are based on criteria developed by Jones and Stol Associates as part of the U.S. Bureau of Reclamation's Draft EIS on w marketing for the American River Service area (USBR, 1988, Tech. Appe D.) The supportive data for the indices is meager, thus it is diffic to be specific on standards.

8. The model is limited to "post-Folsom" hydrology.

9. The use of median monthly for below normal, dry and critical water ye from the Bureau's 56 year operation study is adequate to show differe in flow impacts on salmon habitat and survival.

10. The model is adequately sensitive to show significant differences in or temperature that have an effect on salmon.

11. The use of median monthly water temperatures for below normal, dry ar critical water years from the Bureau's 56 year operation study is adequate to show differences in flow impacts on salmon habitat and survival.

Use of the Bureaus predicted flows and water temperatures for the yea 2020 are appropriate for comparing project alternative flow regimes.

Lower American River
Salmon Habitat Index Model

Overall Salmon Habitat Index = HI

$$HI = \frac{ISP + IWR + ISR}{3}$$

Where ISP = Spawning Index
Where IWR = Winter Rearing Index
Where ISR = Spring Rearing Index

Spawning Index = ISP = (SPF) (SPT)
Where SPF = spawning flow index

Spawning flow is compared for the month of November because November is the only month wherein project operations could affect a change. October temperatures are generally too warm and December temperatures are not a problem. The spawning flow index for November evaluates suitability of flc for spawning based on depth, velocity and temperature control.

SPF = 1.0 if flow is $\geq$ 2750 or $\leq$ 10,000 cubic feet per second.

Flow	Index
$\geq$ 2750 $\leq$ 15000	1.0
2500	.95
2250	.90
2000	.80
1750	.75
1500	.60
1250	.50
1000	.40
750	.30
500	.20
250	.10
0	0

The spawning temperature index evaluates water temperature conditions durin the month of November. Once again, generally October temperatures are too and project flows lack capability to lower them. December temperatures are generally suitable and not a problem for management. Criteria for this ind follows Jones and Stokes Assoc. 1988. See Technical Appendix D, page D-6, column 5A[d] (Attachment 1).

SPT = Spawning temperature index = Index in November
= Median November temperature of below normal, dry and critical years

Table 2. Survival of Chinook Salmon Eggs at Various Water Temperatures

Temperature[a] (°F)	S_H^b	S_M^c	S_A^d	t^e	P_M^f	MII^g
40	0.93	0.98	0.98	110	0.14	0.87
41	0.95	0.98	0.98	100	0.15	0.88
42	0.97	0.99	0.99	91	0.16	0.90
43	0.98	0.99	0.99	84	0.18	0.91
44	0.99	1.00	1.00	77	0.19	0.93
45	0.99	1.00	1.00	70	0.21	0.95
46	0.99	1.00	1.00	66	0.23	0.97
47	0.99	1.00	1.00	62	0.24	0.98
48	0.99	0.99	0.99	59	0.25	0.98
49	0.99	0.99	0.99	55	0.27	1.00
50	0.98	0.99	0.94	52	0.29	0.98
51	0.97	0.98	0.93	49	0.31	0.98
52	0.96	0.97	0.91	47	0.32	0.97
53	0.94	0.96	0.88	45	0.33	0.94
54	0.92	0.94	0.83	42	0.36	0.92
55	0.90	0.93	0.77	41	0.37	0.86
56	0.88	0.91	0.60	39	0.38	0.68
57	0.85	0.88	0.20	37	0.41	0.23
58	0.80	0.83	0.00	35	0.43	0.00
59	0.74	0.77	0.00	34	0.44	0.00
60	0.57	0.60	0.00	33	0.45	0.00
61	0.19	0.20	0.00	31	0.48	0.00
62	0.00	0.00	0.00	0	0.00	0.00

[a] Constant water temperature over the incubation period.

[b] Survival from fertilization to hatching (from Figure 1).

[c] Survival over 1 month.

[d] Survival over 1 month adjusted for daily variation around monthly mean temperatures

[e] Days required to hatch (Alderice and Velsen 1978).

[f] Proportion of development over 1 month (Alderice and Velsen 1978).

[g] Monthly incubation index.

DEIS APPENDIX TBLS/

Winter Rearing Index = IWR = $\frac{IWRF + IWRTG}{2}$

Where IWRF = Winter Rearing Flow Index
Where IWRTG = Winter Rearing temperature growth index

Winter Rearing Flow Index = IWRF

Where IWRF = index of median flow of $\frac{\text{January + February + March}}{3}$

See table below for flow and index

Flow	Index
≥4000	1.0
3500	.95
3000	. 9
2500	. 8
2000	. 6
1500	.55
1000	.50
500	.25
250	.10

Winter Rearing temperature Growth Index = IWRTG

Where IWRTG = Index of median temperature of $\frac{\text{January + February + March}}{3}$

See temp./index table below

Median Monthly Temp. °F	Index
<41.9	0
42-44	.2
44.1-45.9	.5
46-47.9	.6
48-49.9	.7
50-51.9	.9
52-53.9	1.00
54-55.9	1.00
56-57.9	.9
58-59.9	.8
60-61.9	.7
62-63.9	.5
64-65.9	.25
66-67.9	.1
68-69.9	0

Lower American River
Spring Rearing Index

Spring Rearing Index = ISR = $\frac{\text{IFSR + ITGSR = ISSr}}{3}$

Where IFSR = spring flow rearing index = flow index Apr. + May + June

Where ITGSR = spring temperature growth component = median temp. growth index Apr. + May + June

Where ISSR = spring rearing survival component = median temp. growth index $\frac{\text{Apr. + May + June}}{3}$

spring flow rearing index = IFSR = see table below

Median Monthly Flow

Flow	Index
≥2950 ≤15,000	1.00
2750	.95
2500	.90
2250	.85
2000	.80
1750	.75
1500	.60
1250	.50
1000	.40
750	.30
500	.20
250	.10
0	0

Spring temperature growth component = ITGSR = growth index for $\frac{\text{Apr + May + June}}{3}$

See Jones and Stokes 1988, Technical Appendix D. Page D-6 column d MRI_A^d. Temperature index is below.

Temperature (°F)	MRI_A^d
43	0.81
44	0.85
45	0.91
46	0.96
47	0.99
48	1.00
49	1.00
50	1.00
51	1.00
52	1.00
53	1.00
54	0.94
55	0.92
56	0.90
57	0.86
58	0.83
59	0.78
60	0.73
61	0.69
62	0.61
63	0.56
64	0.49
65	0.42
66	0.34
67	0.27
68	0.16
69	0.
70	0.
71	0.
72	0.
73	0.

Spring Rearing Survival Index = ISSR = med. temp. survival index

$$\frac{\text{Apr + May + June}}{3}$$

See Jones and Stokes 1988, Technical Appendix D, page D-9, column a. Temperature/survival index is shown below.

Temperature (°F)	S_{45}[a]
43	0.93
44	0.94
45	0.95
46	0.96
47	0.97
48	0.97
49	0.98
50	0.98
51	0.98
52	0.98
53	0.98
54	0.98
55	0.98
56	0.98
57	0.98
58	0.97
59	0.97
60	0.97
61	0.96
62	0.95
63	0.94
64	0.93
65	0.92
66	0.90
67	0.82
68	0.67
69	0.54
70	0.40
71	0.27
72	0.13
73	0.00

Lower American River
Salmon Habitat Model Indices

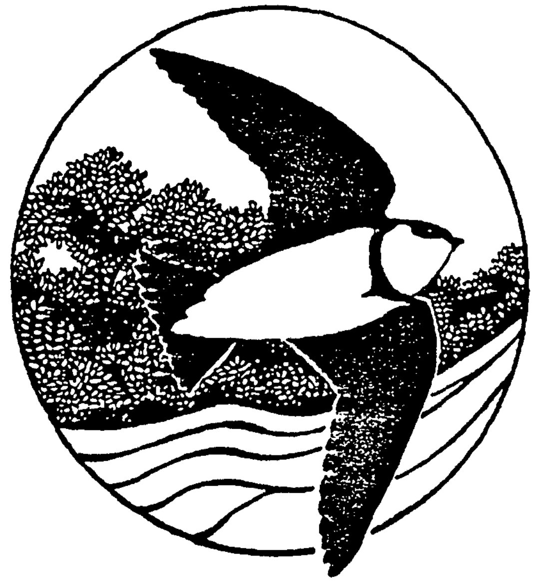
Index	Code	Baseline	500,000	590,000	650,000
Spawning Temp. Index	SPT	.360	.440	.160	.100
Spawning Flow Index	SPF	.760	.727	.780	.910
Spawning Index	ISP	. 27	.319	. 12	.090
Winter Year Flow Index	IWRF	.576	.580	.557	.556
Winter Temp. Index	IWRT6	.733	. 73	.733	.700
Winter Rearing Index	IWR	.420	.423	.407	.389
Spring Rear Flow Index	IFSR	. 65	.652	. 63	. 58
Spring Rear Temp/Growth Index	ITGSR	.635	.600	.546	.533
Spring Rear Temp Surv. Index	ITSSR	. 92	. 87	. 87	. 83
Spring Rearing Index		.735	.707	.682	.647

Overall Habitat Index = HI

$$HI = \frac{ISP + IWR + ISr}{3}$$

HI	ISp	+	IWR	+	ISR	HI Sum divided by 3	Adjust Baseline to 1.0
Baseline	.27		.42		.74	.48 x 2.08	1.0
590	.12		.41		.68	.39 x 2.08	.81
650	.09		.39		.65	.38 x 2.08	.79
500	.32		.42		.71	.48 x 2.08	1.0

APPENDIX C



APPENDIX

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT OFFICE
SACRAMENTO, CALIFORNIA

DRAFT
HABITAT EVALUATION PROCEDURE
AMERICAN RIVER WATERSHED PROJECT
LOWER AMERICAN RIVER AREA
SACRAMENTO COUNTY, CALIFORNIA

by
Jini Scammell-Tinling
Fish and Wildlife Biologist

June 1990

INTRODUCTION

The Corps of Engineers' American River Watershed Project involves three separate areas, the Natomas area in Sacramento County, the Lower American River area within Sacramento County, and the Auburn Dam site in Placer County. This report deals only with the Lower American River area of the project. The Lower American River traverses Sacramento County. The project involves flood control enhancements and features which would provide this area with 100 and 150 year flood protection. The Lower American River portion of the American River Watershed Project is roughly bounded by Sunrise Boulevard at the top and the confluence of the American and Sacramento Rivers at the bottom.

Two alternatives have been proposed for the Lower American River area. One alternative would provide levee structures capable of supporting 180,000 cfs flows in conjunction with 650,000 acre-feet (AF) of storage at Folsom Reservoir, the other would provide 590,000 acre-feet of flood storage capacity at Folsom Reservoir without any change in channel releases. Project designs include increasing existing levee elevations, widening of levees, and changes in drain locations. Project induced losses versus without project conditions would consist of a net loss of 652.36 acres of wetlands under the 650,000 AF with 180,000 cfs alternative, and 143.41 acres of wetlands under the 590,000 AF alternative over the without project scenario (Table 1). Although upland grasslands will be initially impacted by the project under each alternative, the conversion of wetland acreage to grassland and woodland acreages will result in a net gain in upland acres.

Table 1. Net Changes in Acreages for Each Alternative under With and Without Project Scenarios.

180,000 cfs & 650,000 AF Alternative			
		At the End of 100 Years	
	Starting Acres	Without Project	With Project
Wetlands	4001.72	2510.33	1857.97
Uplands	991.10	2482.49	3134.85
	4992.82	4992.82	4911.63
590,000 AF Alternative			
		At the End of 100 Years	
	Starting Acres	Without Project	With Project
Wetlands	3604.52	2270.12	2126.71
Uplands	336.90	1671.30	1814.71
	3941.42	3941.42	3841.42

A tentative compensation area has been identified. This site is comprised of 170 acre grain field and a 240 acre pasture. These would be converted to a wetland complex of palustrine forested, scrub-shrub and emergent. Conversion would be accomplished via contouring, planting, and flooding of the area.

METHODOLOGY

The 1980 Habitat Evaluation Procedures (HEP) were used in the field analysis conducted during the spring of 1989. Participants in the HEP were Jane Rinck, U.S. Army Corps of Engineers, Bellory Fong, California Department of Water Resources, Jini Scammell- Tinling, Monty Knudsen, and Gary Taylor of the U.S. Fish and Wildlife Service.

The basic unit for analysis in the 1980 HEP is the "habitat type" defined in terms of plant species composition or soil/water regime characteristics. Five habitat types were identified for evaluation of Lower American River baseline habitat conditions. These were (1) palustrine forested; (2) palustrine emergent; (3) palustrine scrub shrub; (4) ruderal grasslands, characterized by forbs and annual grasses such as wild oats; and (5) oak woodland. The wetland habitats, i.e., the palustrine habitats require in-kind mitigation. Sample sites were evaluated in each habitat type. Since the Corps asked the Fish and Wildlife Service to minimize the time on this portion of the American River Watershed Project, sample values from the Natomas Area of the project were used in the Lower American River analyses.

Table 2. Thomas' Life Form Categories.

GUILD NUMBER	BREEDS	FEEDS
1	In Water	In Water
2	In Water	Ground, bushes, trees, water
3	Ground around Water	Ground, bushes, trees, water
4	On Ground	On Ground
5	On Ground	Bushes, trees or air
6	In Bushes	Ground, water or air
7	Bushes	Trees, bushes, air
8	Deciduous trees	Trees, bushes, air
9	Deciduous trees	On Ground
10	On very thick branches	On Ground or in Water
11	Own or natural cavity	Trees, bushes, ground, air
12	Other excavated or natural cavity	Ground, water or Air
13	Underground burrow	On ground or under it
14	Underground burrow	Air or water

Sample sites within habitat types were evaluated and rated to determine their capacity to support a number of evaluation species known to commonly occur in that habitat type. The number of species included in the HEP analysis was based on a life form concept developed by Thomas (1979). Thomas (1979) developed 16 life forms based on specific combinations of habitat requirements for reproduction and feeding. Table 2 lists these life form descriptions. Two of the 16 life forms developed by Thomas (1979) (i.e., life forms 15 and 16) were not represented in the Lower American River analyses. Evaluation species representing the life forms were selected by the HEP team from an area species list. The list was compiled from the Wildlife Habitat Relations database, land-use planning documents, and other sources. Table 3 lists the evaluation species by life form and habitat type(s) in which value ratings were calculated.

Table 3. Evaluation Element - Habitat Type Matrix. Evaluation elements used in the analyses and the habitat types to which each was applied.

MODEL NAME	HABITAT TYPE[1] PFO	PSS	PEM	UG	UTSD	GRAIN
WESTERN FENCE LIZARD	2[2]			2		
RUFOUS-SIDED TOWHEE					3	
GREAT BLUE HERON	4	4	4			
MUSKRAT (herbaceous wetlands)	5	5	5			
WOOD DUCK (year-round)	11	11	11			
YELLOW WARBLER	12					
BLACK-SHOULDERED KITE	13	13				
GRAY SQUIRREL (revised)	14				14	
DOWNY WOODPECKER	15					
WESTERN FLYCATCHER	17				17	
SORA			18			
RED-LEGGED FROG	19	19	19			
CALIFORNIA VOLE				20		
ACORN WOODPECKER					21	
SHORT-EARED OWL (Grassland)				24		
NORTHERN ORIOLE	25					
MINK (for. & shr. wetl. <405)	26	26				
MINK (herbaceous wetlands)			27			
SHORT-EARED OWL (Grain & Row)						30
RING-NECKED PHEASANT (Breed)				31		31
WILD TURKEY				33		

1 - Habitat Type acronyms
- PFO - Palustrine Forest
- PEM - Palustrine Emergent
- PSS - Palustrine Scrub Shrub
- UG - Grassland
- UTSD - Oak Woodland

2 - Model Number in LAMERICN.HLB Micro-HSI Library

Fish and Wildlife Service published Habitat Suitability Index (HSI) models were not available for all of the selected evaluation species. Mechanistic models developed in this office, draft word models developed by the Soil Conservation Service, and published and draft Fish and Wildlife Service models were used to evaluate project impacts. Micro-HSI versions, i.e., computerized versions, are attached. Draft word models were converted to mechanistic models. All models were entered into the Habitat Suitability Index software package (Version 1.2) for data processing simplification. California Wildlife Habitat Relationships Species Notes (California Department of Fish and Game 1984), which summarize key life history information and species/community lists were used to develop evaluation species lists for each habitat type.

The capacity of each sample site to meet wildlife needs within the project impact and compensation areas was measure by the HEP team through specific habitat variables. Variable measurements for sample sites of the same habitat type were averaged when appropriate, based upon the suitability index curve for that variable, and the range of values obtained in the field. Average variable values were then entered into the HSI software package, and an HSI produced for each cover type, yielding a rating on a scale of 0.0 to 1.0, with higher numerical ratings indicative of more suitable sample sites for the evaluation species.

The HSI, which is a number between 0.0 and 1.0, with 1.0 representing habitat of highest quality, is a measure of the capacity of the project area to meet life requisites of the species evaluated. The HSI, when multiplied by the areas of each habitat type used by the evaluation species, yields the total number of Habitat Units (HU's), a measure of the quality and quantity of habitat available to the evaluation species. Relative Value Indices (RVI's), or special weighting factors, were not used in the analysis. All evaluation species were assumed to have equal resource value.

For the Lower American River area, HEP was used to evaluate baseline habitat conditions at the proposed project impact and compensation sites for the evaluation species listed in Table 3. Eight future scenario were evaluated (four for each alternative): (1) the future with the flood control projects (Corps) (no habitat management), (2) the future without the flood control project, (3) the future with habitat management of the compensation area(s), and (4) the future without habitat management of the compensation area(s). Using HSI values produced in the baseline habitat evaluation as a guide, and information provided by the Corps, and information from other agencies, future habitat variable values, HSI values and acreages were predicted for the above scenarios based on a 3-year construction period and 100 year project life for the 650,000 AF alternative; and a 1 year construction period and 100 year project life for the 590,000 AF alternative. The period of analysis for the HEP is the sum of the construction period and project life.

Wildlife impacts associated with each future scenario were evaluated for a number of target years. Target Years are those points during the project life when either the quality or quantitiy of the habitat changes. The principle change for these analyses was considered to be acreages, with HSI values varying only as acreage ratios changes. The only notable exception to this is in backwater areas. By the 2020 (Target Year 25), habitat values would be one-quarter their existing values because of water contract buildout. Tables 4 and 6 list projected habitat acreage changes for the target years chosen for each without-project scenario. Tables 5 and 7 list the expected changes in acreage under the with-project scenarios. Tables 8 and 9 describe the with and without project scenarios expected with each alternative. To predict changes in habitat variable/ HSI values for each future scenario, a number of assumptions were made regarding baseline and future habitat values and land uses within the project impact and compensation areas. These assumptions are listed in Tables 10 and 11. Given these assumptions, long-term losses and gains in HU's could be estimated for each future scenario over the life of the project, then expressed as Average Annualized Habitat Unit (AAHU) gains or losses.

The Service's mitigation goal is to assure that recommended compensation is consistent with the fish and wildlife values involved. Resources cover a range of habitat values from those considered to be unique and irreplaceable to those believed to be of low value to fish and wildlife resources. Habitat types to be impacted by the Lower American River portion of the American River Watershed project fall into two categories. Wetland habitats in the project area is considered to be of high value to wildlife and relatively scarce on a regional basis. The goal for this habitat type, therefore, is to prevent any net loss of in-kind habitat value. The goal for other habitat types to be affected by the flood control project (upland, agricultural lands) is to minimize the loss of habitat value. However, for the purposes of this analysis, wetland mitigation was considered acceptable as compensation for non-wetland habitat losses.

Based on the above, each HEP analysis (for each alternative)was divided into two sub analyses: (1) wetland habitat losses with the flood control project versus wetland habitat gains on the compensation areas, and (2) all other habitat losses and gains with the project. This treatment of the data prevented trading off habitat losses for multi-cover evaluation species (i.e., species that occur in more than one habitat type) with gains in other less valuable wildlife habitat types. For example, losses in wetland habitat for the muskrat would not be offset or replaced by gains in grain habitat.

Table 4. Changes in Habitat Type Acreages Under the 650,000 AF and 180,000 cfs Without-Project Scenario.

Covertype		TARGET YEARS 0	1	25	53	103	NET CHANGE
PFO	D	128.20	126.92	99.72	75.26	75.26	-52.94
	I	1036.39	1026.03	806.13	608.40	608.40	-427.99
	B/W	185.61	183.01	130.47	98.47	98.47	-87.14
		1350.20	1335.96	1036.32	782.13	782.13	
OW	D	186.00	184.14	144.67	109.19	109.19	-76.81
	I	81.64	80.82	63.50	47.93	47.93	-33.71
	B/W	45.36	44.72	31.89	24.06	24.06	-21.30
		313.00	309.69	240.06	181.18	181.18	
PEM	D	12.00	11.88	9.33	7.04	7.04	-4.96
	B/W	36.72	36.21	25.81	19.48	19.48	-17.24
		48.72	48.09	35.15	26.53	26.53	
PSS	D	71.00	70.29	55.23	41.68	41.68	-29.32
	I	2023.52	2003.28	1573.94	1187.88	1187.88	-835.64
	B/W	195.28	192.55	137.27	103.60	103.60	-91.68
	+PFO D		0.45	9.97	18.53	18.53	
	+PFO I		3.63	80.59	149.80	149.80	149.80
	+PFO B/W		0.91	19.30	30.50	30.50	30.50
		2289.80	2271.11	1876.29	1531.99	1531.99	
WETLAND SUBTOTALS	D	397.20	393.68	318.92	251.70	233.17	-145.50
	I	3141.55	3113.76	2524.16	1994.00	2001.05	-1152.50
	B/W	462.97	457.40	344.74	276.12	276.12	-186.85
		4001.72	3964.84	3187.82	2521.82	2510.33	
GRASSLAND	D	93.20	93.20	93.20	93.20	93.20	0.00
	I	336.90	336.90	336.90	336.90	336.90	-0.00
	+PFO	0.00	6.41	141.25	255.63	255.63	255.63
	+OW		3.31	72.94	131.82	131.82	131.82
	+PEM		0.63	13.57	22.19	22.19	22.19
	+PSS		23.68	523.37	956.64	956.64	956.64
	+GRAIN		0.00	0.00	0.00	0.00	
		430.10	464.13	1181.23	1796.39	1796.39	
WOODLAND	D						0.00
	I		2.85	62.78	113.61	113.61	113.61
		0.00	2.85	62.78	113.61	113.61	
GRAIN	D	561.00	561.00	561.00	561.00	561.00	0.00
		561.00	561.00	561.00	561.00	561.00	
TOTAL ACREAGE		4992.82	4992.82	4992.82	4992.82	4992.82	

Table 5. Changes in Habitat Type Acreages Under 650,000AF & 180,000cfs With-Project Scenario.

Habitat	Types	0	1	3	7	25	53	103	NET CHANGE
					TARGET YEARS				
PFO	D	128.20	0.00	0.00	0.00	0.00	0.00	0.00	-128.20
	I	1036.39	1026.03	1005.61	946.62	721.15	472.32	472.32	-564.07
	B/W	185.61	183.01	177.92	164.78	116.67	76.41	76.41	-109.20
		1350.20	1209.04	1183.53	1111.40	837.82	548.74	548.74	-801.46
OW	D	186.00	0.00	0.00	0.00	0.00	0.00	0.00	-186.00
	I	81.64	80.82	79.22	74.57	56.81	37.21	37.21	-44.43
	B/W	45.36	44.72	43.48	40.27	28.51	18.67	18.67	-26.69
		313.00	125.55	122.70	114.84	85.32	55.88	55.88	-257.12
PEM	D	12.00	0.00	0.00	0.00	0.00	0.00	0.00	-12.00
	B/W	36.72	36.21	35.20	32.60	23.08	15.12	15.12	-21.60
		48.72	36.21	35.20	32.60	23.08	15.12	15.12	-33.60
PSS	D	71.00	0.00	0.00	0.00	0.00	0.00	0.00	-71.00
	I	2023.52	2003.28	1963.42	1848.24	1408.02	922.20	922.20	-1101.32
	B/W	195.28	192.55	187.19	173.37	122.75	80.39	80.39	-114.89
	+PFO I		3.63	10.77	31.42	110.33	197.42	197.42	197.42
	+PFO B/W		0.91	2.69	7.29	24.13	38.22	38.22	38.22
		2289.80	2200.37	2164.08	2060.32	1665.23	1238.23	1238.23	-1051.57
WETLAND	D	397.20	0.00	0.00	0.00	0.00	0.00	0.00	-397.20
SUB-	I	3141.55	3113.76	3059.02	2900.84	2296.32	1629.15	1629.15	-1512.40
TOTALS	B/W	462.97	457.40	446.49	418.31	315.14	228.82	228.82	-234.15
		4001.72	3571.16	3505.50	3319.15	2611.45	1857.97	1857.97	-2143.75
GRASSLND	D	93.20	0.00	409.20	409.20	409.20	409.20	409.20	316.00
	I	336.90	336.90	336.90	336.90	336.90	336.90	336.90	-0.00
	+PFO		5.83	17.31	49.77	172.88	302.97	302.97	302.97
	+OW		1.45	4.30	12.16	41.68	71.12	71.12	71.12
	+PEM		0.51	1.52	4.12	13.64	21.60	21.60	21.60
	+PSS		22.97	68.19	197.20	688.03	1216.21	1216.21	1216.21
	+GRAIN		561.00	561.00	561.00	561.00	561.00	561.00	
		430.10	928.67	1398.42	1570.35	2223.33	2919.00	2919.00	2488.90
RIPRAP	D			81.20	81.20	81.20	81.20	81.20	81.20
		0.00	0.00	81.20	81.20	81.20	81.20	81.20	81.20
"DIRT"	P		81.20						81.20
	T		409.20						409.20
		0.00	490.40	0.00	0.00	0.00	0.00	0.00	490.40
WOODLAND	I		2.59	7.69	22.12	76.84	134.65	134.65	134.65
		0.00	2.59	7.69	22.12	76.84	134.65	134.65	134.65
GRAIN	D	561.00	0.00	0.00	0.00	0.00	0.00	0.00	-561.00

Table 6. Changes in Habitat Type Acreages Under Without 590,000 AF Project Alternative.

Habitat Types		TARGET YEARS 0	1	25	53	103	NET CHANGE
PFO	D	0.00	0.00	0.00	0.00	0.00	0.00
	I	1036.39	1026.03	806.13	608.40	608.40	-427.99
	B/W	185.61	183.01	130.47	98.47	98.47	-87.14
		1222.00	1209.04	936.60	706.87	706.87	-515.13
OW	D	0.00	0.00	0.00	0.00	0.00	0.00
	I	81.64	80.82	63.50	47.93	47.93	-33.71
	B/W	45.36	44.72	31.89	24.06	24.06	-21.30
		127.00	125.55	95.39	71.99	71.99	-55.01
PEM	B/W	36.72	36.21	25.81	19.48	19.48	-17.24
		36.72	36.21	25.81	19.48	19.48	-17.24
PSS	I	2023.52	2003.28	1573.94	1187.88	1187.88	-835.64
	B/W	195.28	192.55	137.27	103.60	103.60	-91.68
	+PFO I		3.63	80.59	149.80	149.80	149.80
	+PFO B/W		0.91	19.30	30.50	30.50	30.50
		2218.80	2200.37	1811.10	1471.78	1471.78	-747.02
WETLAND	I	3141.55	3113.76	2524.16	1994.00	1994.00	-1147.55
SUBTOTALS	B/W	462.97	457.40	344.74	276.12	276.12	-186.85
		3604.52	3571.16	2868.90	2270.12	2270.12	-1334.40
GRASSLAND	I	336.90	336.90	336.90	336.90	336.90	-0.00
	+PFO	0.00	5.83	128.43	231.81	231.81	231.81
	+OW		1.45	31.61	55.01	55.01	55.01
	+PEM		0.51	10.91	17.24	17.24	17.24
	+PSS		22.97	507.59	927.32	927.32	927.32
		336.90	367.67	1015.44	1568.27	1568.27	1231.37
WOODLAND	I		2.59	57.08	103.03	103.03	103.03
		0.00	2.59	57.08	103.03	103.03	103.03
TOTAL ACREAGE		3941.42	3941.42	3941.42	3941.42	3941.42	

Table 7. Changes in Habitat Type Acreage Under With-Project (590,000 AF Alternative) Scenario.

Habitat Types		0	1	25	51	101	NET CHANGE
				TARGET YEARS			
PFO	I	1036.39	1026.03	767.94	561.06	561.06	-475.33
	B/W	185.61	183.01	124.27	90.79	90.79	-94.82
		1222.00	1209.04	892.20	651.85	651.85	-570.15
OW	I	81.64	80.82	60.49	44.20	44.20	-37.44
	B/W	45.36	44.72	30.37	22.19	22.19	-23.17
		127.00	125.55	90.86	66.38	66.38	-60.62
PEM	B/W	36.72	36.21	24.58	17.96	17.96	-18.76
		36.72	36.21	24.58	17.96	17.96	-18.76
PSS	I	2023.52	2003.28	1499.37	1095.44	1095.44	-928.08
	B/W	195.28	192.55	130.74	95.52	95.52	-99.76
	+PFO I		3.63	93.96	166.37	166.37	166.37
	+PFO B/W		0.91	21.47	33.19	33.19	33.19
		2218.80	2200.37	1745.54	1390.52	1390.52	-828.28
WETLAND	I	3141.55	3113.76	2421.76	1867.06	1867.06	-1274.49
SUBTOTALS	B/W	462.97	457.40	331.43	259.65	259.65	-203.32
		3604.52	3571.16	2753.19	2126.71	2126.71	-1477.81
GRASSLAND	I	336.90	336.90	336.90	336.90	336.90	-0.00
	+PFO		5.83	148.41	256.57	256.57	256.57
	+OW		1.45	36.14	60.62	60.62	60.62
	+PEM		0.51	12.14	18.76	18.76	18.76
	+PSS		22.97	588.69	1027.84	1027.84	1027.84
		336.90	367.67	1122.27	1700.68	1700.68	1363.78
WOODLAND	I		2.59	65.96	114.03	114.03	114.03
		0.00	2.59	65.96	114.03	114.03	114.03
TOTAL ACREAGE		3941.42	3941.42	3941.42	3941.42	3941.42	

Table 8. Predicted Habitat Changes for Future Scenario Target Years 650,000 AF Storage and 180,000cfs flows Alternative.

Scenario/Target Year	Predicted Habitat Changes
Future Without Flood Control Project	
Target Year 0	Baseline habitat conditions - site characterized by wetlands (palustrine forest, emergent and scrub-shrub, and open water) and uplands.
Target Year 1	Same as baseline. Annual one percent loss of all wetland acreage and an additional 0.4 percent loss in backwater acreages from Bureau Reclamation fulfillment of water contracts.
Target Year 25	Bureau of Reclamation water contracts completed, losses from this source eliminated.
Target Year 53	Annual one percent loss ceases. Study area reaches steady state.
Target Year 103	Conditions same as in Target Year 53.
Future With Flood Control Project	
Target Year 0	Baseline habitat conditions. Study area characterized by wetland and upland habitat types.
Target Year 1	Levee construction along the Lower American River and Sacramento Weir begins. Removal of upland and wetland vegetation begins. Loss of 1.0 percent per year of Palustrine Forest, Open Water, Palustrine Emergent and Palustrine Scrub-shrub. Bureau of Reclamation water contracting causes an additional 0.4 percent per year loss in riparian vegetation in backwater areas.
Target Year 3	Construction complete. Revegetation of levees areas (borrows and staging areas need to be included in final analysis) completed. Natural revegetation of grasses and forbs in Sacramento Bypass begins. Folsom Reservoir space increased from 400,000AF to 650,000AF during flood season. Riparian corridor vegetation losses increase to 1.5 percent per year.
Target Year 25	Bureau of Reclamation fills water supply contracts. Upland values unchanged.
Target Year 53	Rate of vegetation loss reaches equilbrium with gains.
Target Year 103	Same conditions as in TY 53.

Table 8 continued. Predicted Habitat Changes with 650,000 AF Alternative continued.

<u>Future With Flood Control Project</u> <u>No Habitat Management of Compensation Area</u>	
Target Year 0	Baseline habitat conditions, grain and pasture fields
Target Year 1	Flood control project construction begins; agriculturaluse of compensation area begins to phase out.
Target Year 3	Construction completed; agricultural mitigation area persists.
Target Year 103	Same as Target Year 3.
<u>Future With Flood Control Project</u> <u>and Management of Compensation Area</u>	
Target Year 0	Baseline conditions. Site characterized by grain field and pasture.
Target Year 1	Site contoured for wetland. Emergent vegetation planted, trees (cottonwoods, oaks) and shrub species (willows). Year-round water source secured and applied.
Target Year 6	Vegetation maturing. Emergent marsh reaches end point value to evaluation species. Scrub-shrub values increasing.
Target Year 11	Tree species achieve tree status, i.e., greater than 4 meters tall. Palustrine forested acreage present.
Target Year 21	Optimum snag density achieved.
Target Year 53	Maximum palustrine forested values achieved.
Target Year 103	Values generally the same as in TY 53, i.e., homeostasis reached. End of project life.

Table 9. Predicted Habitat Changes for Future Target Years under 590,000 AF Alternative.

Scenario/Target Year	Predicted Habitat Changes
Future Without Flood Control Project (No Habitat Management)	
Target Year 0	Baseline habitat conditions - site characterized by wetlands (palustrine forest, emergent and scrub-shrub, and open water) and uplands.
Target Year 1	Same as baseline. Annual one percent loss of all wetland acreage and an additional 0.4 percent loss in backwater acreages from Bureau Reclamation fulfillment of water contracts.
Target Year 25	Bureau of Reclamation water contracts completed, losses from this source eliminated.
Target Year 51	Annual one percent loss ceases. Study area reaches steady state.
Target Year 101	Conditions same as in Target Year 51.
Future With Flood Control Project (No Habitat Management)	
Target Year 0	Baseline habitat conditions. Study area characterized by wetland and upland habitat types. Bureau of Reclamation water contracting causes an additional 0.4 percent per year loss in riparian vegetation in backwater areas.
Target Year 1	Loss of 1.0 percent per year of Palustrine Forest, Open Water, Palustrine Emergent and Palustrine Scrub-shrub. Folsom Reservoir space increased from 400,000AF to 590,000AF during flood season. Riparian corridor vegetation losses increase to 1.2 percent per year plus 0.4 percent from Bureau water contracts..
Target Year 25	Bureau of Reclamation fills water supply contracts. Upland values unchanged.
Target Year 51	Rate of vegetation loss reaches equilbrium with gains.
Target Year 101	Same conditions as in TY 51.

Table 9 continued. Predicted Habitat Changes Under 590,000 AF Alternative Continued.

<u>Future With Flood Control Project</u> <u>No Habitat Management of Compensation Area</u>	
Target Year 0	Baseline habitat conditions, grain and pasture fields
Target Year 1	Flood control project instituted; agricultural use of compensation area begins to phase out.
Target Year 101	Same as Target Year 1.
<u>Future With Flood Control Project</u> <u>and Management of Compensation Area</u>	
Target Year 0	Baseline conditions. Site characterized by grain field and pasture.
Target Year 1	Site contoured for wetland. Emergent vegetation planted, trees (cottonwoods, oaks) and shrub species (willows). Year-round water source secured and applied.
Target Year 6	Vegetation maturing. Emergent marsh reaches end point value to evaluation species. Scrub-shrub values increasing.
Target Year 11	Tree species achieve tree status, i.e., greater than 4 meters tall. Palustrine forested acreage present.
Target Year 21	Optimum snag density achieved.
Target Year 51	Maximum palustrine forested values achieved.
Target Year 101	Values generally the same as in TY 53, i.e., homeostasis reached. End of project life.

Table 10. Assumptions Used in Predicting Future Scenarios - 650,000 AF with 180,000 cfs flows Alternative.

Future Scenario	Assumptions
Future Without Flood Control Project (No Habitat Management)	1. Existing habitats are: Project Area: a. palustrine forest b. palustrine emergent c. open water d. palustrine scrub-shrub e. grassland f. oak woodland g. grain Compensation Area: grain (170 acres) and pasture (240 acres), 410 acres total
	2. Goal of evaluation is to replace natural habitat values, thereby requiring the system be modelled ecologically, rather than based on aesthetic or recreational values.
	3. One percent annual loss of wetland acreage until 2048. Palustrine forest conversions to Palustrine Scrub-shrub (35%), Grassland (45%) and Woodland (20 %). All other wetland losses converted completely to grasslands.
	4. Bureau of Reclamation water contract buildout will diminish backwater acreages in the study area by 0.4 % annually until contract buildout in 2020.
Future With Flood Control Project (No Habitat Management	1. Habitats within the construction zone will be removed.
	2. Some areas lost to construction will be replaced with managed grasslands along levee slopes.
	3. Habitat values on lands adjacent to project impact lands will not be diminished.
	4. Additional annual wetland losses of 0.5 percent from project impacts will occur through Target Year 53 (2048)
	5. Sacramento Bypass is a mitigation area, therefore wetland acreages doubled to reflect double impacts, i.e., mitigate for current project and remitigate for the original project.
	6. Project construction will last three years. Term of the project is 100 years. Level of flood protection is 150 years.
Future With Flood Control Project Without Habitat Management of Compensation Area	1. Compensation area is grain and pasture area, 170

Table 10 continued. Assumptions used in 650,000 AF Alternative continued.

Future With Flood Control Project With Habitat Management of Compensation Area	1. Compensation area is grain and pasture area, 170 and 240 acres, respectively. 2. Compensation area will be converted to lower, mid and upper terrace riparian forest (40%), emergent (28%) and scrub-shrub (7%) habitat with areas of open water (25%), and a permanent water supply. 3. Planting of the compensation area will begin in concert with initiation of the flood control project. 4. Compensation areas will be planted with trees such as Fremont cottonwoods, valley, interior live, blue and oracle oak, and shrubs such as sandbar, yellow, arroyo, red, Gooding's and dusky willow, and elderberry; and vines such as blackberry and wild rose. Emergent vegetation will consist of _Typha_ and _Scirpus_ spp. All vegetation will be fertilized at planting and irrigated for 2-3 years until established. The density of plantings will be: oaks 100 per acre cottonwoods 200 per acre willows 400 per acre 5. Generally an increase in percent canopy cover of herbaceous cover in first year. Density and value of emergent/submergent cover reaches a maximum at target year 6. Temperature in littoral zone is high initially, with gradual cooling as emergent, shrub and tree canopy increases. 6. No trees (i.e., woody vegetation greater than four meters) until target year 11. DBH increases with age. No average tree DBH until TY 11. Then DBH will increase approximately 1-2 inches per year. Tree density will also increase at TY 11 when shrubs become trees. A maximum density will be reached, and then some thinning will occur as competition eliminates some individuals, yielding snags. 7. Shrubs - start with one gallon stock (tree species) and willow whips. Minimal canopy cover initially. Maximum density at TY 11. Followed by decline as overstory trees shade out some shrubs. 8. Snags - optimum density achieved at TY 21 with constant density level thereafter.

Table 11. Assumptions Used in Predicting Future Scenarios - 590,000 AF Alternative.

Future Scenario	Assumptions
Future Without Flood Control Project (No Habitat Management)	
	1. Existing habitats are: Project Area: a. palustrine forest b. palustrine emergent c. open water d. palustrine scrub-shrub e. grassland f. oak woodland Compensation Area: grain (170 acres) and pasture (240 acres), 410 acres total
	2. Goal of evaluation is to replace natural habitat values, thereby requiring the system be modelled ecologically, rather than based on aesthetic or recreational values.
	3. One percent annual loss of wetland acreage until 2046. Palustrine forest conversions to Palustrine Scrub-shrub (35%), Grassland (45%) and Woodland (20 %). All other wetland losses converted completely to grasslands.
	4. Bureau of Reclamation water contract buildout will diminish backwater acreages in the study area by 0.4 % annually until contract buildout in 2020.
Future With Flood Control Project (No Habitat Management	
	1. Habitats within the construction zone will be removed.
	2. Some areas lost to construction will be replaced with managed grasslands along levee slopes.
	3. Habitat values on lands adjacent to project impact lands will not be diminished.
	4. Additional annual wetland losses of 0.2 percent from project impacts will occur through Target Year 51 (2046)
	5. Project construction will last three years. Term of the project is 100 years. Level of flood protection is 100 years.
Future With Flood Control Project Without Habitat Management of Compensation Area	
	1. Compensation area is grain and pasture area, 170 and 240 acres, respectively.

Table 11 continued. Assumptions for 590,000 AF Alternative continued.

Future With Flood Control Project With Habitat Management of Compensation Area	1. Compensation area is grain and pasture area, 170 and 240 acres, respectively.
	2. Compensation area will be converted to lower, mid and upper terrace riparian forest (40%), emergent (28%) and scrub-shrub (7%) habitat with areas of open water (25%), and a permanent water supply.
	3. Planting of the compensation area will begin in concert with initiation of the flood control project.
	4. Compensation areas will be planted with trees such as Fremont cottonwoods, valley, interior live, blue and oracle oak, and shrubs such as sandbar, yellow, arroyo, red, Gooding's and dusky willow, and elderberry; and vines such as blackberry and wild rose. Emergent vegetation will consist of *Typha* and *Scirpus* spp. All vegetation will be fertilized at planting and irrigated for 2-3 years until established. The density of plantings will be: oaks 100 per acre cottonwoods 200 per acre willows 400 per acre
	5. Generally an increase in percent canopy cover of herbaceous cover in first year. Density and value of emergent/submergent cover reaches a maximum at target year 6. Temperature in littoral zone is high initially, with gradual cooling as emergent, shrub and tree canopy increases.
	6. No trees (i.e., woody vegetation greater than four meters) until target year 11. DBH increases with age. No average tree DBH until TY 11. Then DBH will increase approximately 1-2 inches per year. Tree density will also increase at TY 11 when shrubs become trees. A maximum density will be reached, and then some thinning will occur as competition eliminates some individuals, yielding snags.
	7. Shrubs - start with one gallon stock (tree species) and willow whips. Minimal canopy cover initially. Maximum density at TY 11. Followed by decline as overstory trees shade out some shrubs.
	8. Snags - optimum density achieved at TY 21 with constant density level thereafter.

RESULTS

Wetland Areas

Results of the field evaluation of the 650,000 AF wetland baseline conditions are shown in Table 12. HSI values for baseline conditions varied from 0.10 to 1.00 for wetland species in the project impact area. For all species combined, the average HSI value was approximately 0.59 for the existing palustrine emergent, forested and scrub-shrub in the area. This value indicates that the total available habitat within the project impact area is above average in its capacity to support the evaluation species.

Table 12. Baseline Wetland Habitat Units (Form B), 650,000 AF Alternative.

Study Name: L.American R. - June Revisions
Action: PA 1 (without project) Baseline Wetlands
Target Year: 0

Evaluation Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
Western Fence Lizard	1663.20	0.52	864.86
Great Blue Heron	4001.70	1.00	4001.70
Muskrat	4001.70	0.10	400.17
Wood Duck	4001.70	0.43	1720.73
Yellow Warbler	1663.20	0.56	931.39
Blk-shouldered Kite	3953.00	0.75	2964.75
Gray Squirrel	1663.20	0.49	814.97
Downy Woodpecker	1663.20	0.50	831.60
Western Flycatcher	1663.20	0.91	1513.51
Sora	48.70	0.17	8.28
Red-legged Frog	4001.70	0.67	2681.14
Northern Oriole	1663.20	0.78	1297.30
Mink	4001.70	0.73	2921.24

Results of the field evaluation of the 590,000 AF wetland baseline conditions are shown in Table 13. HSI values for baseline conditions varied from 0.09 to 1.00 for wetland species in the project impact area. For all species combined, the average HSI value was approximately 0.58 for the existing palustrine emergent, forested and scrub-shrub in the area. This value indicates that the total available habitat within the project impact area is above average in its capacity to support the evaluation species.

Table 13. Baseline Wetland Habitat Units for 590,000 AF Alternative (Form B).

Study Name: L.American R. - June Revisions
Action: PA 5 (without project) 590AF Storage
Target Year: 0

Evaluation Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
Western Fence Lizard	1349.00	0.52	701.48
Great Blue Heron	3604.50	1.00	3604.50
Muskrat	3604.50	0.09	324.41
Wood Duck	3604.50	0.38	1369.71
Yellow Warbler	1349.00	0.56	755.44
Blk-shouldered Kite	3567.80	0.76	2711.53
Gray Squirrel	1349.00	0.49	661.01
Downy Woodpecker	1349.00	0.50	674.50
Western Flycatcher	1349.00	0.91	1227.59
Sora	36.70	0.17	6.24
Red-legged Frog	3604.50	0.66	2378.97
Northern Oriole	1349.00	0.78	1052.22
Mink	3604.50	0.72	2595.24

Baseline conditions for the proposed

Table 14. Baseline Habitat Units on Hypothetical Grain and Pasture Mitigation Parcel (Form B).

Study Name: L.American R. - June Revisions
Action: MP 1 (without project) Grain/Pasture Parcel
Target Year: 0

Evaluation Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
Western Fence Lizard	0.00	0.00	0.00
Great Blue Heron	0.00	0.00	0.00
Muskrat	0.00	0.00	0.00
Wood Duck	0.00	0.00	0.00
Yellow Warbler	0.00	0.00	0.00
Blk-shouldered Kite	0.00	0.00	0.00
Gray Squirrel	0.00	0.00	0.00
Downy Woodpecker	0.00	0.00	0.00
Western Flycatcher	0.00	0.00	0.00
Sora	0.00	0.00	0.00
Red-legged Frog	0.00	0.00	0.00
Northern Oriole	0.00	0.00	0.00
Mink	0.00	0.00	0.00
Short-eared Owl	410.00	0.86	352.60
Ring-necked Pheasant	170.00	0.77	130.90

mitigation/compensation areas are shown in Table 14. HSI values varied from 0.0 to 0.87 for grain and pasture habitat in the compensation areas (410 acres). For all species combined, the average HSI value was 0.11 in the proposed compensation area. These values indicate that the total habitat within the compensation sites combined was well below average in its capability to support the evaluation species.

Changes in wetland AAHU's are compared in Figure 1 for the future with the 650,000 AF flood control alternative (no habitat management) versus the future without the project. The total change in AAHU's is -3,566.45. This value indicates that construction of the flood control project without a compensation plan for wetland habitat losses would result in a net loss in habitat value for all evaluation species combined. Conversely, adoption of the scenario - the future with habitat management on the compensation areas versus the future without management of the compensation areas - would result in a net gain of 1241.02 AAHU's with the compensation plan (Figure 2).

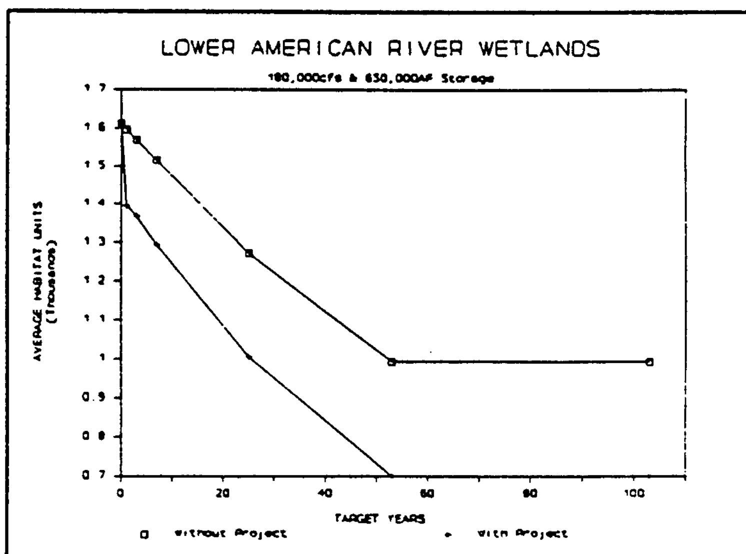


Figure 1. Changes in wetland habitat units under with- and without- project conditions (650,000 AF alternative).

Changes in wetland AAHU's are compared in Figure 3 for the future with the 590,000 AF flood

control alternative (no habitat management) versus the future without the project. The total change in AAHU's is -613.38. This value indicates that construction of the flood control project without a compensation plan for wetland habitat losses would result in a net loss in habitat value for all evaluation species combined. Conversely, adoption of the scenario - the future with habitat management on the compensation areas versus the future without management of the compensation areas - would result in a net gain of 1205.61 AAHU's with the compensation plan (Figure 2)

Figure 2. Changes in mitigation parcel habitat units with and without management.

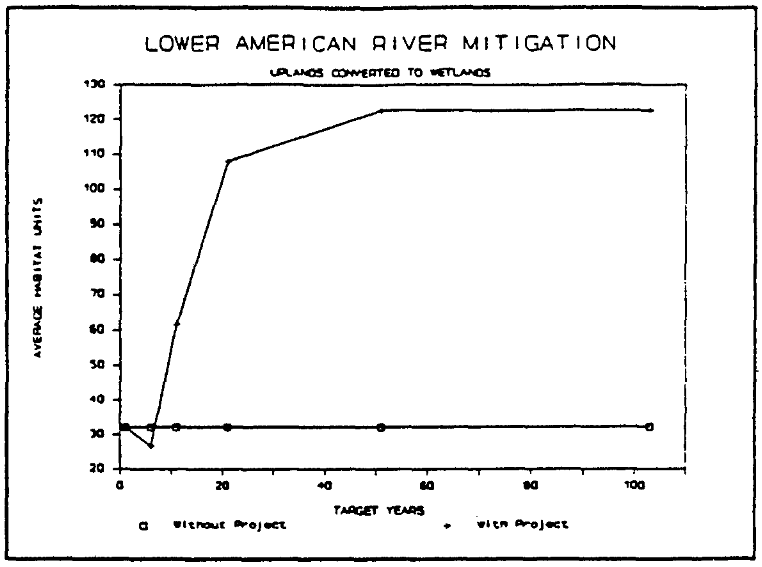


Table 15. shows the in-kind compensation needed in acres for wetland impacts from the 650,000 AF alternative of the Lower American River segment. Adoption of this alternative would result in the loss of 652.36 acres of wetland habitat. Thecompensation plan indicates 1410.03 acres would be needed for compensation. This is consistent with the Services policy regarding wetlands, requiring no net loss in value or acres; therefore, the 1410.03 acres would have to be restored.

Figure 3. Changes in wetland habitat units with- and without- project (590,000 AF).

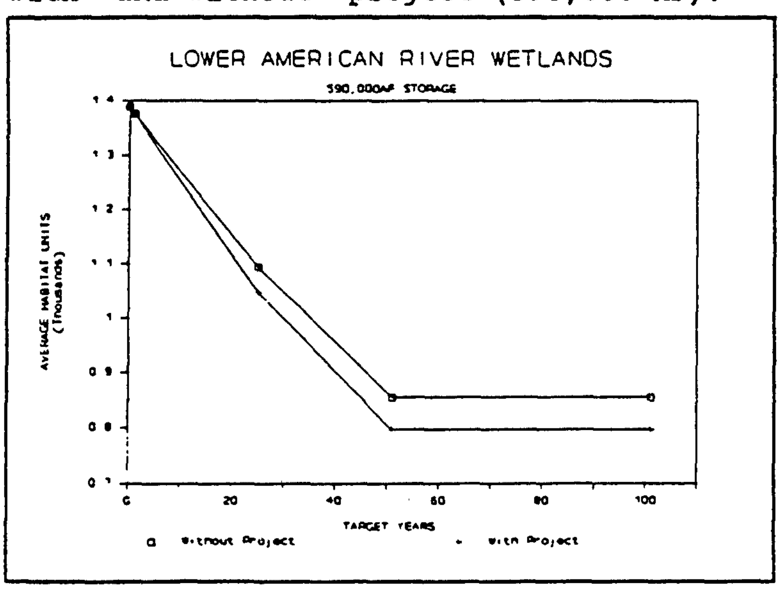


Table 16. shows the in-kind compensation needed in acres for wetland impacts from the 590,000 AF alternative of the Lower American River segment. Adoption of this alternative would result in the loss of 143.41 acres of wetland habitat. The compensation plan indicates 257.21 acres would be needed for compensation. This is consistent with the Services policy regarding wetlands, requiring no net loss in value or acres; therefore, 257.21_ acres would have to be restored.

Table 15. Area Needed for In-Kind Compensation of Wetland Impacts (650,000 AF (Form H).

Study Name: L.American R. - June Revisions
Plan Alternative:PA 2 (with project) Wetland Impacts
Compared To: PA 1 (without project) 650AF & 180cfs Wetln
Management Plan: MP 2 (with project) GRAIN/PASTURE W/MGMT
Compared To: MP 1 (without project) GRAIN & PASTURE MIT
Candidate Management Area Size: 410.00

Evaluation Species Name	Net Change In AAHU's Plan Alternative	Management Plan	Area Needed For Compensation
Western Fence Lizard	-182.14	77.55	962.90
Great Blue Heron	-606.58	396.07	627.92
Muskrat	-60.66	27.50	904.50
Wood Duck	-260.83	149.80	713.88
Yellow Warbler	-196.13	80.33	1001.07
Blk-shouldered Kite	-446.25	189.24	966.81
Gray Squirrel	-171.62	71.91	978.48
Downy Woodpecker	-175.12	70.96	1011.81
Western Flycatcher	-318.72	135.72	962.84
Sora	-1.97	19.20	42.16
Red-legged Frog	-406.41	254.81	653.86
Northern Oriole	-273.19	114.10	981.65
Mink	-466.83	135.74	1410.03

Table 16. Area Needed for In-Kind Compensation of Wetland Impacts from 590,000 AF Storage Alternative (Form H).

Study Name: L.American R. - June Revisions
Plan Alternative: PA 6 (with project) WETLAND IMPACTS
Compared To: PA 5 (without project) 590AF Storage
Management Plan: MP 4 (with project) WITH MANAGEMENT
Compared To: MP 3 (without project) 590AF Mitigation

Candidate Management Area Size: 410.00

Evaluation Species Name	Net Change In AAHU's Plan Alternative	Management Plan	Area Needed For Compensation
Western Fence Lizard	-25.98	78.10	136.39
Great Blue Heron	-118.09	395.79	122.33
Muskrat	-10.63	27.49	158.49
Wood Duck	-44.87	149.68	122.91
Yellow Warbler	-27.98	80.13	143.17
Blk-shouldered Kite	-88.76	189.15	192.39
Gray Squirrel	-24.48	71.74	139.92
Downy Woodpecker	-24.98	70.74	144.88
Western Flycatcher	-45.47	135.45	137.63
Sora	-0.21	19.19	4.48
Red-legged Frog	-77.94	254.52	125.54
Northern Oriole	-38.97	113.83	140.38
Mink	-85.02	135.53	257.21

UPLAND AREAS

Results of the field evaluation of the 650,000 AF alternative upland under baseline conditions are shown in Table 17. HSI values for baseline conditions varied from 0.55 to 0.95 for species in the project impact area. For all species combined, the average HSI value was approximately 0.77 for the existing upland habitat in this area. This value indicates that the total available habitat within the project impact area is slightly above average in its capacity to support the

evaluation species.

Table 17. Upland Baseline Habitat Units for Lower American River segment of American River Watershed Project (Form B).

Study Name: L.American R. - June Revisions
Action: PA 3 (without project) Upland Baseline
Target Year: 0

Evaluation Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
Gray Squirrel	0.00	0.60	0.00
Western Flycatcher	0.00	0.95	0.00
Rufous-sided Towhee	0.00	0.68	0.00
California Vole	430.10	0.97	417.20
Acorn Woodpecker	0.00	0.66	0.00
Short-eared Owl	991.10	0.90	891.99
Ring-necked Pheasant	991.10	0.55	545.11
Turkey	430.10	0.84	361.28

Results of the field evaluation of the 590,000 AF alternative uplands under baseline conditions are shown in Table 18. HSI values for baseline conditions varied from 0.60 to 1.00 for species in the project impact area. For all species combined, the average HSI value was approximately 0.81 for the existing upland habitat in this area. This value indicates that the total available habitat within the project impact area is slightly above average in its capacity to support the evaluation species.

Changes in AAHU's with the 650,000 AF alternative are compared in Figure 4 for the future with the flood control project (no habitat management) versus the future without the project. The total change in AAHU's is 4192.31. This value indicates that construction of the flood control project without a compensation plan for upland habitat losses would not result in a net loss in habitat value for all evaluation species combined. Conversely, adoption of the scenario - the future with habitat management on the compensation areas versus the future without management of the compensation areas - would result in a net gain of 1241.02 AAHU's with the compensation plan (Figure 2), for an over compensation of losses.

Table 18. Upland Baseline Habitat Units for Lower American River segment of American River Watershed Project (Form B).

Study Name: L.American R. - June Revisions
Action: PA 3 (without project) Upland Baseline
Target Year: 0

Evaluation Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
Gray Squirrel	0.00	0.60	0.00
Western Flycatcher	0.00	0.95	0.00
Rufous-sided Towhee	0.00	0.68	0.00
California Vole	336.90	0.97	326.79
Acorn Woodpecker	0.00	0.66	0.00
Short-eared Owl	336.90	0.78	262.78
Ring-necked Pheasant	336.90	1.00	336.90
Turkey	336.90	0.84	283.00

Changes in AAHU's with the 590,000 AF alternative are compared in Figure 5 for the future with the flood control project (no habitat management) versus the future without the project. The total change in AAHU's is 417.68. This value indicates that construction of the flood control project without a compensation plan for upland habitat

losses would not result in a net loss in habitat value for all evaluation species combined. Conversely, adoption of the scenario - the future with habitat management on the compensation areas versus the future without management of the compensation areas - would result in a net gain of 1205.61 AAHU's with the compensation plan (Figure 2), for an over compensation of losses.

Figure 4. Changes in upland habitat units under with- and without- project (650,000 AF) conditions. The area between the lines represents the AAHU's requiring compensation.

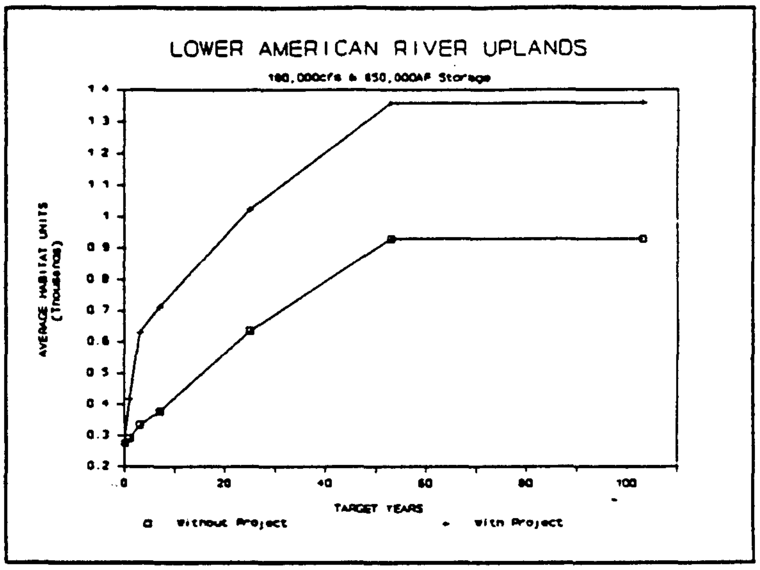


Table 18 shows the compensation area needed in acres for the 650,000 AF alternative uplands. Adoption of this alternative would result in the loss of 81.19 acres of upland habitat. The compensation plan indicates that the project would compensate for project related losses in values.

Figure 5. Changes in upland Habitat Units under with- and without- project (590,000 AF) conditions. The area between the lines represents the AAHU's requiring compensation.

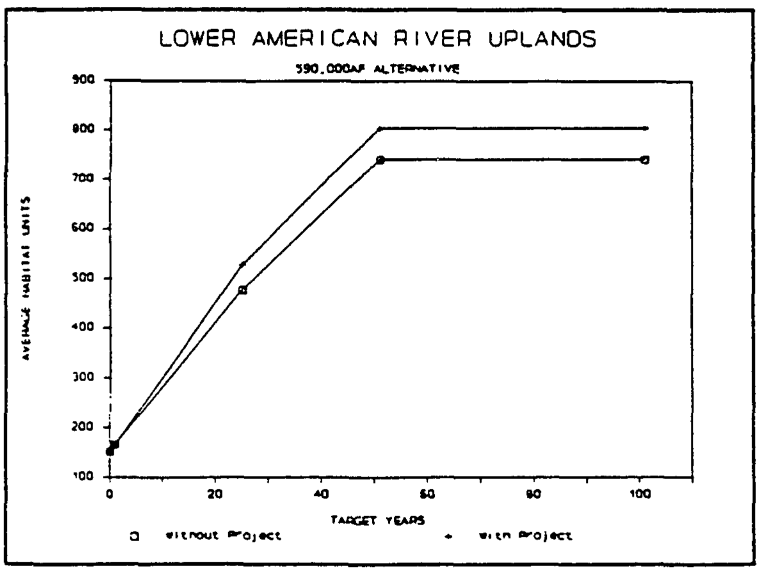


Table 19 shows the compensation area needed in acres for the 590,000 AF alternative uplands. Adoption of this alternative would result in the loss of 100 acres of upland habitat. The compensation plan indicates that the project would

Table 19. Area Needed for Equal or Relative Compensation of Upland Impacts from 650,000 AF Storage & 180,000cfs Alternative (Form H).

compensate for project related losses in values.

Study Name: L.American R. - June Revisions
Plan Alternative: PA 4 (with project) 650 Upland Impacts
Compared To: PA 3 (without project) 650AF & 180CFS UPLND
Management Plan: MP 2 (with project) GRAIN/PASTURE W/MGMT
Compared To: MP 1 (without project) GRAIN & PASTURE MIT
Candidate Management Area Size: 410.00
Source of Relative Value Indices: All Equal To 1.0

Evaluation Species Name	Net Change In AAHU's: Plan Alternative	Net Change In AAHU's: Management Plan
Western Fence Lizard	0.00	77.55
Great Blue Heron	0.00	396.07
Muskrat	0.00	27.50
Wood Duck	0.00	149.80
Yellow Warbler	0.00	80.33
Blk-shouldered Kite	0.00	189.24
Gray Squirrel	10.01	71.91
Downy Woodpecker	0.00	70.96
Western Flycatcher	15.84	135.72
Sora	0.00	19.20
Red-legged Frog	0.00	254.84
Northern Oriole	0.00	114.10
Mink	0.00	135.74
Rufous-sided Towhee	11.34	0.00
California Vole	1029.64	0.00
Acorn Woodpecker	11.01	0.00
Short-eared Owl	271.58	-351.46
Ring-necked Pheasant	959.17	-130.48

** YOU HAVE OVER COMPENSATED -1206.422

Table 24. Area Needed for Equal or Relative Compensation of Upland Impacts from 590,000 AF Storage Alternative (Form H).

Study Name: L.American R. - June Revisions
Plan Alternative: PA 8 (with project) UPLAND IMPACTS 590AF
Compared To: PA 7 (without project) UPLANDS - 590AF
Management Plan: MP 4 (with project) GRAIN/PASTURE W/MGMT
Compared To: MP 2 (without project) GRAIN & PASTURE MIT
Candidate Management Area Size: 410.00
Source of Relative Value Indices: All Equal To 1.0

Evaluation Species Name	Net Change In AAHU's: Plan Alternative	Net Change In AAHU's: Management Plan
Western Fence Lizard	0.00	78.10
Great Blue Heron	0.00	395.79
Muskrat	0.00	27.49
Wood Duck	0.00	149.68
Yellow Warbler	0.00	80.13
Blk-shouldered Kite	0.00	189.15
Gray Squirrel	5.44	71.74
Downy Woodpecker	0.00	70.74
Western Flycatcher	8.61	135.45
Sora	0.00	19.19
Red-legged Frog	0.00	254.52
Northern Oriole	0.00	113.83
Mink	0.00	135.53
Rufous-sided Towhee	6.16	0.00
California Vole	105.78	0.00
Acorn Woodpecker	5.98	0.00
Short-eared Owl	85.06	-343.29
Ring-necked Pheasant	109.05	-127.44

** YOU HAVE OVER COMPENSATED -158.83

LITERATURE CITED

Thomas, J.W., ed. 1979. Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington. U.S. Dept. of Agric. Handbook No. 553, Washington, D.C., 512pp.

U.S.Fish and Wildlife Service. 1980. Habitat Evaluation Procedures. Ecological Services Manual 102. U.S. Dept. of Interior, Wash., D.C.

Library: D:LAMERICN.HLB
6-29-1990

Model # 2 Single covertype model.
Model name: Western Fence Lizard
Verification level: Expert Review
Creation/modification date: 5-3-1989

Covertypes:

PFO	:	Palustrine forested wetland
UTSD	:	Deciduous tree savanna
UG	:	Grassland
UFOD	:	Deciduous Forest
USHD	:	Deciduous shrubland

```
Lev 5     Lev 4     Lev 3     Lev 2     Lev 1
ECVGr01--grf------prd------gem------gem--HSI
ECVGr01--grf-------^        |        |
          JUS01----mnu-------|        |
          ASzObjt--grf-------^        |
          ECVGr01--grf------gem-------^
          ECVST02--grf-------^
```

Habitat variables:

ASzObjt :Average size (feet) of ground cover objects (logs,fences,woodpiles...)
ECVGr01 :Percent ground cover, includes rocks,logs,branches,fences,woodpiles...
ECVST02 : % Canopy Cover of living vegetation > 6 ft above ground
JUS01 : Structural diversity/interspersion - # CT's and amount of edge

GRAPH FUNCTION at level 4, position 1
Title: % Ground Cover (logs,woodpile,fence...)

X:	0.000,	Y:	0.000
X:	25.000,	Y:	1.000
X:	70.000,	Y:	1.000
X:	100.000,	Y:	0.000

GRAPH FUNCTION at level 4, position 2
Title: % Ground cover

X:	0.000,	Y:	0.000
X:	25.000,	Y:	1.000
X:	70.000,	Y:	1.000
X:	100.000,	Y:	0.000

MENU FUNCTION at level 3, position 2

Menu choice:	1	Output value:	0.100
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	1.000

GRAPH FUNCTION at level 3, position 3

Title: Average size of ground cover objects

X: 0.000,	Y: 0.000
X: 1.000,	Y: 0.200
X: 2.000,	Y: 0.800
X: 3.000,	Y: 1.000
X: 5.000,	Y: 1.000

GRAPH FUNCTION at level 3, position 4

Title: % Ground Cover

X: 0.000,	Y: 0.000
X: 25.000,	Y: 1.000
X: 70.000,	Y: 1.000
X: 100.000,	Y: 0.000

GRAPH FUNCTION at level 3, position 5

Title: % Canopy Cover of vegn > 6 ft above grd

X: 0.000,	Y: 1.000
X: 50.000,	Y: 1.000
X: 90.000,	Y: 0.000
X: 100.000,	Y: 0.000

Comments:

<none>

Library: D:LAMERICN.HLB
6-29-1990

Model # 4 Single covertype model.
Model name: GREAT BLUE HERON
Verification level: EXPERT REVIEW
Creation/modification date: 6-29-1989

SHORT, H. L. AND R. J. COOPER. 1985. HABITAT SUITABILITY INDEX MODELS: GREAT BLUE HERON. U.S. FISH WILDL. SERV. BIOL. REP. FWS/OBS-82/10.99. 23 PP.
Applies to treeland habitats near water as potential heronry sites, and aquatic habitats near potential heronry sites as foraging habitats.
Range: throughout the species' range in the U.S.

Covertypes:

E2AB	: Estuarine intertidal aquatic bed
E2EM	: Estuarine intertidal emergent wetland
E2FO	: Estuarine intertidal forested wetland
E2SS	: Estuarine intertidal scrub/shrub wetland
E2US/	: Estuarine intertidal shore & bottom classes (US/RS/RF/SB)
L2	: Lacustrine littoral subsystem
PAB	: Palustrine aquatic bed
PEM	: Palustrine emergent wetland
PFO	: Palustrine forested wetland
PSS	: Palustrine scrub/shrub wetland
PUB/	: Palustrine shore & bottom classes (UB/RB/US)
R4	: Riverine, intermittent
R5AB	: Riverine aquatic bed
R5EM	: Riverine emergent wetland
R5UB/	: Riverine shore & bottom classes (UB/RB/SB/US/RS)
AP	: Pasture or hayland

```
Lev 3     Lev 2     Lev 1
 X99V1----grf------usf--HSI
 X99V2----mnu-------|
 X99V3----mnu-------|
 X99V4----mnu-------|
 X99V5----mnu-------|
 X99V6----grf-------^
```

Habitat variables:

X99V1	: Distance between potential nest sites & foraging areas (km)
X99V2	:Pres. of water body with suitable prey pop. & forag. substr. (N=1,Y=2)
X99V3	: Pres. of disturb.-free zone of 100m around forag. area (N=1,Y=2)
X99V4	: Presence of treeland cover type within 250m of wetland (N=1,Y=2)
X99V5	: Presence of 250m (land) or 150m (water) disturb.-free zone (N=1,Y=2)
X99V6	: Proximity of potential nest site to an active nest (km)

GRAPH FUNCTION at level 2, position 1
Title: DIST. BETWEEN NEST & FORAGING SITES

```
     X:       0.000,    Y:   1.000
     X:       1.000,    Y:   1.000
     X:      10.000,    Y:   0.100
     X:      15.000,    Y:   0.100

MENU FUNCTION at level 2, position 2
     Menu choice:        1      Output value:   0.000
     Menu choice:        2      Output value:   1.000

MENU FUNCTION at level 2, position 3
     Menu choice:        1      Output value:   0.000
     Menu choice:        2      Output value:   1.000

MENU FUNCTION at level 2, position 4
     Menu choice:        1      Output value:   0.000
     Menu choice:        2      Output value:   1.000

MENU FUNCTION at level 2, position 5
     Menu choice:        1      Output value:   0.000
     Menu choice:        2      Output value:   1.000

GRAPH FUNCTION at level 2, position 6
  Title:  PROXIMITY OF POTENTIAL/ACTIVE NEST
     X:       0.000,    Y:   1.000
     X:       1.000,    Y:   1.000
     X:      20.000,    Y:   0.100
     X:      25.000,    Y:   0.100

USER-SPECIFIED FUNCTION at level 1, position 1
USUB = (X(1) * X(2) * X(3) * X(4) * X(5) * X(6))^.5

Comments:
AP covertype added to this model
```

Library: D:LAMERICN.HLB
6-29-1990

Model # 5 Single covertype model.
Model name: MUSKRAT (herbaceous wetlands)
Verification level: EXPERT REVIEW
Creation/modification date: 4-29-1987

ALLEN, A.W., AND R.D. HOFFMAN. 1984. HABITAT SUITABILITY INDEX MODELS: MUSKRAT. U.S. FISH WILDL. SERV. FWS/OBS-82/10.46. 27 PP.
Applies to year-round habitat of populations using herbaceous wetlands.
Range: throughout species range of inland freshwater habitats only.

Covertypes:
PEM : Palustrine emergent wetland
PAB : Palustrine aquatic bed
PML : Palustrine moss/lichen wetland
PUB/ : Palustrine shore & bottom classes (UB/RB/US)
PFO : Palustrine forested wetland
PSS : Palustrine scrub/shrub wetland

```
Lev 4     Lev 3     Lev 2     Lev 1
 VCVEM01--grf------gem------min--HSI
 TFRDP01--grf-------^        |
 VCVEM01--grf------gem-------^
 X46V8----grf-------^
```

Habitat variables:
TFRDP01 : Percent of year with surface water present within cover type (%)
VCVEM01 : % canopy cover of emergent herbaceous plants (pers. & non-pers.) (%)
X46V8 : % emerg. herb. veg. consisting of Olney or 3 sq. bulrush, cattail (%)

GRAPH FUNCTION at level 3, position 1
Title: % CANOPY COVER OF EMERGENT VEGETATION

X:	0.000,	Y:	0.050
X:	50.000,	Y:	1.000
X:	80.000,	Y:	1.000
X:	100.000,	Y:	0.900

GRAPH FUNCTION at level 3, position 2
Title: % OF YR. WITH SURFACE WATER PRESENT

X:	0.000,	Y:	0.000
X:	50.000,	Y:	0.000
X:	75.000,	Y:	0.100
X:	100.000,	Y:	1.000

GRAPH FUNCTION at level 3, position 3
Title: % CANOPY COVER OF EMERGENT VEGETATION

```
     X:      0.000,   Y:   0.050
     X:     50.000,   Y:   1.000
     X:     80.000,   Y:   1.000
     X:    100.000,   Y:   0.900

GRAPH FUNCTION at level 3, position 4
  Title:  % OF EMERGENT HERBACEOUS VEGETATION
     X:      0.000,   Y:   0.100
     X:     20.000,   Y:   0.100
     X:     80.000,   Y:   1.000
     X:    100.000,   Y:   1.000

Comments:
     <none>
```

Library: D:LAMERICN.HLB
6-29-1990

Model # 11 Multi-covertype model.
Model name: WOOD DUCK (year-round)
Verification level: Expert Review
Creation/modification date: 4-8-1987

SOUSA, P. J., AND A. H. FARMER. 1983. HABITAT SUITABILITY INDEX MODELS: WOOD DUCK. U.S. FISH WILDL. SERV. FWS/OBS-82/10.43.
27 pp.
Applies to areas where populations are resident throughout the year.
Range: throughout those areas where the breeding and wintering ranges overlap.

Covertypes:

PSS	:	Palustrine scrub/shrub wetland
PEM	:	Palustrine emergent wetland
R5EM	:	Riverine emergent wetland
R4	:	Riverine, intermittent
R5AB	:	Riverine aquatic bed
R5UB/	:	Riverine shore & bottom classes (UB/RB/SB/US/RS)
UFOD	:	Deciduous Forest
PFO	:	Palustrine forested wetland

LIFE REQUISITE: NESTING
Covertypes:
UFOD, PFO, PSS, PEM, R4, R5EM, R5AB, R5UB/

```
Lev 3     Lev 2     Lev 1
 X43V1----usf------grf-LRSI
 X43V2-----^
```

Habitat variables:

X43V1	:	Density of potentially suitable tree cavities (#/ha)
X43V2	:	Density of nest boxes (#/ha)

USER-SPECIFIED FUNCTION at level 2, position 1
USUB=(0.09*X(1))+(0.95*X(2))

GRAPH FUNCTION at level 1, position 1
Title: DENSITY OF POTENTIAL NEST SITES (#/HA)

X:	0.000,	Y:	0.000
X:	12.000,	Y:	1.000
X:	13.000,	Y:	1.000

Comments:
There are typographical errors in the published wood duck model: the equation for determining the density of potential nest sites should be: (0.09 * V1) + (0.95 * V2).

LIFE REQUISITE: BROOD
Covertypes:
PFO, PSS, PEM, R4, R5EM, R5AB, R5UB/

```
Lev 2    Lev 1
X43V4----grf-LRSI
```

Habitat variables:
X43V4 : % of water surface covered by potential brood cover (%)

GRAPH FUNCTION at level 1, position 1
Title: % WATER SURF. COV. BY POTENT. BROOD COV.

```
X:     0.000,   Y:  0.000
X:    50.000,   Y:  1.000
X:    75.000,   Y:  1.000
X:   100.000,   Y:  0.000
```

Comments:
<none>

LIFE REQUISITE: WINTER
Covertypes:
PFO, PSS, PEM, R4, R5EM, R5AB, R5UB/

```
Lev 2    Lev 1
X43V5----grf-LRSI
```

Habitat variables:
X43V5 : % of water surface covered by potential winter cover (%)

GRAPH FUNCTION at level 1, position 1
Title: % WATER SURF. COV. BY POTENT. WINT. COV.

```
X:     0.000,   Y:  0.000
X:    50.000,   Y:  1.000
X:    75.000,   Y:  1.000
```

```
     X:      100.000,    Y:    0.000

Comments:
     <none>

-------------------------------------------------------------------------------
DISTANCE FUNCTION:
  Title:  DISTANCE BETWEEN COVER TYPES
     X:        0.000,    Y:    1.000
     X:        0.800,    Y:    1.000
     X:        3.200,    Y:    0.000
     X:        4.000,    Y:    0.000

-------------------------------------------------------------------------------
HSI TREE DIAGRAM:
                          Lev 4    Lev 3    Lev 2    Lev 1
                           NESTING--grf------min------max--HSI
                           BROOD----grf-------^        |
                                    WINTER---usf-------^


GRAPH FUNCTION at level 3, position 1
  Title:  % EQIVALENT OPTIMUM AREA NESTING
     X:        0.000,    Y:    0.000
     X:       20.000,    Y:    1.000
     X:      100.000,    Y:    1.000


GRAPH FUNCTION at level 3, position 2
  Title:  % EQIUVALENT OPTIMUM AREA BROOD
     X:        0.000,    Y:    0.000
     X:      100.000,    Y:    1.000


USER-SPECIFIED FUNCTION at level 2, position 2
USUB=X(1)/100

Comments:
The distance function does not apply to the WINTER life requisite.  This
function applies only to distances between the NESTING and BROOD life
requisites.  If during HSI analysis, the program prompts for distance
values involving the WINTER life requisite (either distance to a cover
type providing the WINTER life requisite or distance from a cover type
providing the WINTER life requisite to a cover type providing the
NESTING or BROOD life requisite), a distance value of 0.0 should be
entered.
```

Library: D:LAMERICN.HLB
6-29-1990

Model # 12 Single covertype model.
Model name: YELLOW WARBLER
Verification level: EXPERT REVIEW
Creation/modification date: 6-29-1989

SCHROEDER, R.L. 1982. HABITAT SUITABILITY INDEX MODELS:
YELLOW WARBLER. U.S. FISH WILDL. SERV. BIOL. REP.
FWS/OBS-82/10.27. 7 PP.
Applies to breeding.
Range: throughout the breeding range of the species.

Covertypes:
USHD : Deciduous shrubland
PFO : Palustrine forested wetland

```
Lev 3     Lev 2     Lev 1
VCVSH02--grf------usf--HSI
VHTSH05--grf-------|
VRCSH01--grf-------^
```

Habitat variables:
VCVSH02 : Percent canopy cover of deciduous shrubs (i.e., <6m tall) (%)
VHTSH05 : Mean height of deciduous shrub canopy (not of individual shrubs) (m)
VRCSH01 : % of deciduous shrub canopy cover | hydrophytic species (%)

GRAPH FUNCTION at level 2, position 1
Title: % DECIDUOUS SHRUB CROWN COVER

X:	0.000,	Y:	0.000
X:	60.000,	Y:	1.000
X:	80.000,	Y:	1.000
X:	100.000,	Y:	0.600

GRAPH FUNCTION at level 2, position 2
Title: AVERAGE HEIGHT OF SHRUB CANOPY (M)

X:	0.000,	Y:	0.000
X:	2.000,	Y:	1.000
X:	5.000,	Y:	1.000

GRAPH FUNCTION at level 2, position 3
Title: % SHRUB CANOPY COMPRISED OF HYDROPHYTIC SHRUBS

X:	0.000,	Y:	0.100
X:	100.000,	Y:	1.000

USER-SPECIFIED FUNCTION at level 1, position 1
USUB = (X(1)*X(2)*X(3))^.5

Comments:
PSS covertype deleted for this study 6/29/89

Library: D:LAMERICN.HLB
6-29-1990

Model # 14 Single covertype model.
Model name: GRAY SQUIRREL (revised)
Verification level: Expert Review
Creation/modification date: 6-29-1989

ALLEN, A.W. 1987. HABITAT SUITABILITY INDEX MODELS: GRAY SQUIRREL (REVISED)
U.S. FISH WILDL. SERV. BIOL. REP. 82(10.135). 16PP.
Range: Throughout the range of the gray squirrel in North America.

Covertypes:
UFOD : Deciduous Forest
UTSD : Deciduous tree savanna
PFO : Palustrine forested wetland

```
Lev 4     Lev 3    Lev 2    Lev 1
VRCHM01--grf------usf------min--HSI
VSDHM01--hst-------|        |
VCVTR01--grf-------^        |
VCVTR01--grf------gem-------^
VDBTR01--grf-------^
```

Habitat variables:
VCVTR01 : Percent canopy cover of trees (%)
VDBTR01 : Mean DBH of overstory trees (i.e., dia. 1.4m high) (cm)
VRCHM01 : % of tree canopy cover | hard mast producing species (%)
VSDHM01 : Number of hard mast tree species with canopy cover >1% (#)

GRAPH FUNCTION at level 3, position 1
Title: % OF TREE CANOPY HARD MAST SPP.>25CM DBH
X: 0.000, Y: 0.100
X: 100.000, Y: 1.000

HISTOGRAM FUNCTION at level 3, position 2

0.000	<	0.250	=	0.100
0.250	<	0.500	=	0.200
0.500	<	0.750	=	0.500
0.750	<	1.000	=	0.800
1.000	<	1000000.000	=	1.000

GRAPH FUNCTION at level 3, position 3
Title: % CANOPY COVER OF TREES
X: 0.000, Y: 0.000
X: 40.000, Y: 1.000
X: 75.000, Y: 1.000
X: 100.000, Y: 0.800

```
    X:     101.000,   Y:   0.800

GRAPH FUNCTION at level 3, position 4
  Title:  % CANOPY COVER OF TREES
    X:       0.000,   Y:   0.000
    X:      40.000,   Y:   1.000
    X:     100.000,   Y:   1.000

GRAPH FUNCTION at level 3, position 5
  Title:  MEAN DBH OF OVERSTORY TREES (CM)
    X:       0.000,   Y:   0.000
    X:      12.700,   Y:   0.000
    X:      38.100,   Y:   1.000
    X:      50.800,   Y:   1.000

USER-SPECIFIED FUNCTION at level 2, position 1
USUB=((X(1)*X(2))^.5)*X(3)
```

Comments:
THIS MODEL IS A REVISION OF THE GRAY SQUIRREL MODEL PUBLISHED IN 1982 FWS/OBS-82/10.19. THIS MODEL IS BASED ON THE ASSUMPTION THAT UNDERSTORY (E.G., SHRUBS, YOUNG REGENERATION) HAS LESS INFLUENCE ON HABITAT QUALITY FOR GRAY SQUIRRELS THAN DOES THE QUALITY OF WINTER FOOD AND COVER/ REPRODUCTIVE HABITAT REQUIREMENTS. THEREFORE, THE VARIABLE FOR EVALUATION OF SHRUB CANOPY COVER HAS BEEN DELETED FROM THE REVISED MODEL. The function for "V2" (VSDHM01) has been converted to a histogram to facilitate dealing with cases of more than 4 species.
L1P1 = WINTER FOOD LR
L2P2 = COVER REPRODUCTION LR

Library: D:LAMERICN.HLB
6-29-1990

Model # 15 — Single covertype model.

Model name: DOWNY WOODPECKER

Verification level: EXPERT REVIEW
Creation/modification date: 11-06-1985

SCHROEDER, R. L. 1982. HABITAT SUITABILITY INDEX MODELS: DOWNY WOODPECKER. U.S. FISH WILDL. SERV. BIOL. REP. FWS/OBS-82/10.38. 10 PP.

Range: throughout the species' range.

Covertypes:

E2FO	: Estuarine intertidal forested wetland
PFO	: Palustrine forested wetland
UFOD	: Deciduous Forest
UFOE	: Evergreen Forest

```
Lev 3     Lev 2     Lev 1
 VBAWO01--grf------min--HSI
 VDNSN03--grf-------^
```

Habitat variables:

VBAWO01	: Basal area of trees (if cut at 1.4m high) (m^2/ha)
VDNSN03	: Density of snags that have >15cm DBH (#/ha)

GRAPH FUNCTION at level 2, position 1

Title: BASAL AREA (M2 / HA)

X:	0.000,	Y:	0.000
X:	10.000,	Y:	1.000
X:	20.000,	Y:	1.000
X:	30.000,	Y:	0.500
X:	40.000,	Y:	0.500

GRAPH FUNCTION at level 2, position 2

Title: # SNAGS > 15 CM DBH / HA

X:	0.000,	Y:	0.000
X:	12.500,	Y:	1.000
X:	15.000,	Y:	1.000

Comments:

Density of snags rescaled to /ha.

Library: D:LAMERICN.HLB
6-29-1990

Model # 17 Single covertype model.
Model name: WESTERN FLYCATCHER
Verification level: Applied
Creation/modification date: 6-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - WESTERN FLYCATCHER (Empidonax difficilis). U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA, 1984

Covertypes:
UTSD : Deciduous tree savanna
PFO : Palustrine forested wetland

```
Lev 3     Lev 2     Lev 1
 VDNTR02--grf------gem--HSI
 VDBTR01--grf-------|
 GDIwlcy--grf-------^
```

Habitat variables:
GDIwlcy : Distance to canyon bottom or riparian areas (m)
VDBTR01 : Mean DBH of overstory trees (i.e., dia. 1.4m high) (cm)
VDNTR02 : Density of trees (#/ha)

GRAPH FUNCTION at level 2, position 1
Title: Tree Density - # per hectare
X: 0.000, Y: 0.000
X: 81.000, Y: 1.000
X: 300.000, Y: 1.000

GRAPH FUNCTION at level 2, position 2
Title: Stand age - Average dbh (cm)
X: 0.000, Y: 0.000
X: 25.400, Y: 1.000
X: 100.000, Y: 1.000

GRAPH FUNCTION at level 2, position 3
Title: Distance to riparian or canyon bottom
X: 0.000, Y: 1.000
X: 107.000, Y: 1.000
X: 214.000, Y: 0.200
X: 300.000, Y: 0.200

Comments:
Model originally developed for Bureau of Reclamation Enlarged Shasta

project. Adapted for valley area in savanna woodland

Library: D:LAMERICN.HLB
6-29-1990

Model # 18
Model name: SORA

Single covertype model.

Verification level: Author Draft
Creation/modification date: 6-30-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - SORA. Developed from Draft model by U.S. Fish and Wildlife Service, National Ecology Research Center, Fort Collins, Colorado.

Covertypes:
E2EM : Estuarine intertidal emergent wetland
PEM : Palustrine emergent wetland

```
Lev 4     Lev 3    Lev 2    Lev 1
 WSA01----mnu------gem------usf--HSI
 WDP01----grf-------|         |
 WRE03----mnu-------^         |
 VHTHE03--grf------gem--------|
 VCVEM01--grf-------^         |
          GDIIS02--mnu-------^
```

Habitat variables:
GDIIS02 : Interspersion of Sora nest, forage and escape cove
VCVEM01 : % canopy cover of emergent herbaceous plants (pers. & non-pers.) (%)
VHTHE03 : Mean height of herbaceous canopy during spring (cm)
WDP01 : Mean water depth (m)
WRE03 : Mean water level fluctuation (m)
WSA01 : Mean salinity (ppt)

MENU FUNCTION at level 3, position 1

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.650
Menu choice:	3	Output value:	0.650

GRAPH FUNCTION at level 3, position 2
Title: Average water depth (m)

X:	0.000,	Y:	0.000
X:	0.150,	Y:	1.000
X:	0.300,	Y:	1.000
X:	0.500,	Y:	0.000

MENU FUNCTION at level 3, position 3

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.300
Menu choice:	3	Output value:	0.000

```
GRAPH FUNCTION at level 3, position 4
  Title:  Average height (cm) Herbaceous Vegn
     X:        0.000,    Y:   0.000
     X:       60.000,    Y:   1.000
     X:      200.000,    Y:   1.000

GRAPH FUNCTION at level 3, position 5
  Title:  % Cover of cattails, sedges, etc
     X:        0.000,    Y:   0.000
     X:       50.000,    Y:   1.000
     X:       75.000,    Y:   1.000
     X:      100.000,    Y:   0.250

MENU FUNCTION at level 2, position 3
     Menu choice:       1      Output value:   0.200
     Menu choice:       2      Output value:   0.700
     Menu choice:       3      Output value:   1.000

USER-SPECIFIED FUNCTION at level 1, position 1
USUB = (( X(1) * X(2))^0.5)*X(3)

Comments:
R5EM covertype removed from this model for this study.
ebd
```

Library: D:LAMERICN.HLB
6-29-1990

Model # 19 Single covertype model.
Model name: RED-LEGGED FROG
Verification level: Applied
Creation/modification date: 3-28-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - RED-LEGGED FROG. U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. NARRATIVE BY: MARK R. JENNINGS, PhD, California Academy of Sciences. Adapted from USFWS National Ecology Research Center draft model. 1988.

Covertypes:
R5EM : Riverine emergent wetland
PEM : Palustrine emergent wetland
PFO : Palustrine forested wetland
PSS : Palustrine scrub/shrub wetland

```
Lev 4      Lev 3      Lev 2      Lev 1
 HTEII01--grf------gem------min--HSI
 HTEII01--grf-------|        |
 FTIwa01--grf-------|        |
 HFLML01--mnu-------|        |
 HDPFr01--grf-------|        |
 APGz01---mnu-------^        |
 ECVEM04--grf------mea-------^
 VCVHE02--grf-------|
 HFLML02--mnu-------|
 IPF01----mnu-------|
 APGz01---mnu-------^
```

Habitat variables:
APGz01 : Grazing levels (1-none,2-light,3-moderate,4-heavy)
ECVEM04 : % of pool covered by submergent and emergent vegetation
FTIwa01 : Number of months water is present
HDPFr01 : % of water area with 7.5 - 15.2 cm deep water
HFLML01 : Mean water velocity (1 - stagnant, 2-slow, 3-rapid)
HFLML02 : Water velocity for estivation (1-stagnant,2-slow,3-rapid)
HTEII01 : Mean water temperature in littoral zone (C)
IPF01 : Presence of introduced predatory fishes
VCVHE02 : % canopy cover of herbaceous plants within 10m of wetland's edge (%)

GRAPH FUNCTION at level 3, position 1
Title: Mean Water temperature (C) (young)

X:	-10.000,	Y:	0.000
X:	0.000,	Y:	0.000
X:	4.000,	Y:	1.000
X:	21.000,	Y:	1.000
X:	25.000,	Y:	0.000
X:	50.000,	Y:	0.000

```
GRAPH FUNCTION at level 3, position 2
  Title:  Mean water temperature (C)
     X:      -10.000,   Y:   0.000
     X:        0.000,   Y:   0.000
     X:        4.000,   Y:   1.000
     X:       21.000,   Y:   1.000
     X:       25.000,   Y:   0.000
     X:       50.000,   Y:   0.000


GRAPH FUNCTION at level 3, position 3
  Title:  Number of months water is present
     X:        0.000,   Y:   0.000
     X:        6.000,   Y:   1.000
     X:       12.000,   Y:   1.000


MENU FUNCTION at level 3, position 4
     Menu choice:         1       Output value:   0.800
     Menu choice:         2       Output value:   1.000
     Menu choice:         3       Output value:   0.200


GRAPH FUNCTION at level 3, position 5
  Title:  % water area w/ 7.5-15.2 cm deep water
     X:        0.000,   Y:   0.000
     X:       25.000,   Y:   1.000
     X:       75.000,   Y:   1.000
     X:      100.000,   Y:   0.750


MENU FUNCTION at level 3, position 6
     Menu choice:         1       Output value:   1.000
     Menu choice:         2       Output value:   0.800
     Menu choice:         3       Output value:   0.500
     Menu choice:         4       Output value:   0.300


GRAPH FUNCTION at level 3, position 7
  Title:  % of pool covered by submerg & emergent
     X:        0.000,   Y:   0.000
     X:       50.000,   Y:   1.000
     X:       75.000,   Y:   1.000
     X:      100.000,   Y:   0.500


GRAPH FUNCTION at level 3, position 8
  Title:  % herb cover on streambank & pond margin
     X:        0.000,   Y:   0.000
     X:       75.000,   Y:   1.000
     X:      100.000,   Y:   1.000
```

MENU FUNCTION at level 3, position 9

Menu choice:	1	Output value:	0.100
Menu choice:	2	Output value:	1.000
Menu choice:	3	Output value:	0.300

MENU FUNCTION at level 3, position 10

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	0.000

MENU FUNCTION at level 3, position 11

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.800
Menu choice:	3	Output value:	0.500
Menu choice:	4	Output value:	0.300

Comments:
IPF01 1- sunfishes and catfishes absent
2- sunfishes and catfishes present and water covered by >= 25% submergent and emergent vegetation
3- sunfishes and catfishes present and water covered by < 25% submergent and emergent vegetation

Library: D:LAMERICN.HLB
6-29-1990

Model # 20 Single covertype model.
Model name: CALIFORNIA VOLE
Verification level: Applied
Creation/modification date: 3-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - CALIFORNIA VOLE (Microtus californicus). U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. 1988.

Covertypes:

UG	:	Grassland
PEM	:	Palustrine emergent wetland
PAB	:	Palustrine aquatic bed
PSS	:	Palustrine scrub/shrub wetland

```
Lev 3    Lev 2    Lev 1
 VHTHE01--grf------mea--HSI
 VCVHE01--grf-------|
 SS001----mnu-------^
```

Habitat variables:

SS001	:	Soil moisture class (1=moist-saturated,2=moist,3=dry, see lex)
VCVHE01	:	Percent canopy cover of herbs (non-woody plants: grasses & forbs) (%)
VHTHE01	:	Mean height of herbaceous canopy (not of individual plants) (cm)

GRAPH FUNCTION at level 2, position 1
Title: Height of Herbaceous Vegetation

X:	0.000,	Y:	0.000
X:	5.000,	Y:	0.500
X:	10.000,	Y:	0.800
X:	15.000,	Y:	1.000
X:	20.000,	Y:	1.000

GRAPH FUNCTION at level 2, position 2
Title: Percent Cover of Herbaceous Vegetation

X:	0.000,	Y:	0.000
X:	10.000,	Y:	0.100
X:	40.000,	Y:	0.300
X:	60.000,	Y:	0.600
X:	100.000,	Y:	1.000

MENU FUNCTION at level 2, position 3

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	0.200

Comments:
SSO01 - Soil type
1 - soil type is silty or loamy AND friable
2 - soil type is not silty or loamy and moderately friable
3 - soil type is not silty or loamy and is not friable

Library: D:LAMERICN.HLB
6-29-1990

Model # 21 Single covertype model.
Model name: ACORN WOODPECKER
Verification level: Applied
Creation/modification date: 6-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - ACORN WOODPECKER (Melanerpes formicivorus). U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. 1984.

Covertypes:
UFOE : Evergreen Forest
UTSD : Deciduous tree savanna

```
Lev 5     Lev 4     Lev 3     Lev 2     Lev 1
GJUwa01--grf------gem------min------prd--HSI
VSDHM01--hst-------|        |        |
VCVTR01--grf-------|        |        |
EDNSN01--grf-------^        |        |
         EDNTS01--grf-------^        |
                  GARct01--grf-------^
```

Habitat variables:
EDNSN01 : Snag and pole density per hectare
EDNTS01 : Density of trees and snags with dbh > 25.4cm
GARct01 : Estimate of hectares of suitable habitat available
GJUwa01 : Water availability - distance (km) to water source from sample area
VCVTR01 : Percent canopy cover of trees (%)
VSDHM01 : Number of hard mast tree species with canopy cover >1% (#)

GRAPH FUNCTION at level 4, position 1
Title: Distance to water (km)

X:	0.000,	Y:	1.000
X:	0.400,	Y:	1.000
X:	0.600,	Y:	0.700
X:	0.800,	Y:	0.300
X:	1.000,	Y:	0.300

HISTOGRAM FUNCTION at level 4, position 2

0.000	<	1.000	=	0.000
1.000	<	2.000	=	0.300
2.000	<	3.500	=	0.700
3.500	<	1000000.000	=	1.000

GRAPH FUNCTION at level 4, position 3
Title: % Tree Canopy Cover

```
    X:      0.000,   Y:   1.000
    X:     70.000,   Y:   1.000
    X:    100.000,   Y:   0.000

GRAPH FUNCTION at level 4, position 4
  Title:  Snag/pole (granaries) density per ha
    X:      0.000,   Y:   0.000
    X:      0.630,   Y:   0.500
    X:      1.250,   Y:   0.700
    X:      1.880,   Y:   0.800
    X:      2.500,   Y:   0.900
    X:      3.130,   Y:   0.950
    X:      3.750,   Y:   1.000
    X:      4.380,   Y:   1.000
    X:      5.000,   Y:   1.000

GRAPH FUNCTION at level 3, position 2
  Title:  Density per ha trees/snags dbh> 25.4cm
    X:      0.000,   Y:   0.000
    X:      1.000,   Y:   0.300
    X:      1.500,   Y:   0.800
    X:      2.000,   Y:   1.000
    X:      2.500,   Y:   1.000

GRAPH FUNCTION at level 2, position 2
  Title:  Suitable hectares of habitat
    X:      0.000,   Y:   0.000
    X:      1.000,   Y:   0.350
    X:      3.000,   Y:   0.350
    X:      5.000,   Y:   0.700
    X:      6.000,   Y:   1.000
    X:      7.000,   Y:   1.000

Comments:
EDNSN01 - hybrid of Enlarged Shasta model and model from PG&E
```

Library: D:LAMERICN.HLB
6-29-1990

Model # 24 Single covertype model.

Model name: SHORT-EARED OWL (Grassland)

Verification level: Applied

Creation/modification date: 3-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - SHORT-EARED OWL. U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. 1986.

Covertypes:
UG : Grassland

```
Lev 5    Lev 4    Lev 3    Lev 2    Lev 1
 VHTHE01--grf------gem------prd------min--HSI
 VCVHE01--grf-------^        |        |
          GDIHE01--grf-------^        |
 VCVHE01--grf------gem------prd-------^
 ECVHE03--grf-------|        |
 ECVHE03--grf-------^        |
          GDIHE02--grf-------^
```

Habitat variables:
ECVHE03 : % Herbaceous cover Avena, Lolium, Bromus, Picris
GDIHE01 : Distance (km) to herbaceous cover averaging 60 - 90cm tall
GDIHE02 : Distance (km) to herbaceous vegetation 40-75% cover
VCVHE01 : Percent canopy cover of herbs (non-woody plants: grasses & forbs) (%)
VHTHE01 : Mean height of herbaceous canopy (not of individual plants) (cm)

GRAPH FUNCTION at level 4, position 1
Title: Average height of herbaceous vegn (cm)

X:	0.000,	Y:	0.000
X:	61.000,	Y:	1.000
X:	92.000,	Y:	1.000
X:	152.000,	Y:	0.000
X:	200.000,	Y:	0.000

GRAPH FUNCTION at level 4, position 2
Title: Percent herbaceous cover

X:	0.000,	Y:	0.000
X:	60.000,	Y:	1.000
X:	100.000,	Y:	1.000

GRAPH FUNCTION at level 4, position 4
Title: Percent herbaceous cover (forage)

X:	0.000,	Y:	0.000

X: 40.000, Y: 1.000
X: 75.000, Y: 1.000
X: 100.000, Y: 0.200

GRAPH FUNCTION at level 4, position 5
Title: % Cover Ca Vole preferred herb spp.
X: 0.000, Y: 0.500
X: 70.000, Y: 1.000
X: 100.000, Y: 1.000

GRAPH FUNCTION at level 4, position 6
Title: % Ca Vole preferred herbaceous plants
X: 0.000, Y: 0.500
X: 70.000, Y: 1.000
X: 100.000, Y: 1.000

GRAPH FUNCTION at level 3, position 2
Title: Distance (km) roost cover (herb 60-90cm)
X: 0.000, Y: 1.000
X: 5.600, Y: 0.100
X: 10.000, Y: 0.100

GRAPH FUNCTION at level 3, position 4
Title: Distance to forage site (40-75% herb)
X: 0.000, Y: 1.000
X: 5.630, Y: 0.100
X: 10.000, Y: 0.100

Comments:
<none>

Library: D:LAMERICN.HLB
6-29-1990

Model # 25
Single covertype model.
Model name: NORTHERN ORIOLE

Verification level: Applied
Creation/modification date: 3-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - NORTHERN ORIOLE. U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. 1986.

Covertypes:
PFO : Palustrine forested wetland
UTSD : Deciduous tree savanna

```
Lev 3    Lev 2    Lev 1
 VHTDE01--grf------gem--HSI
 ECVTR01--grf-------|
 GWLTR01--mnu-------^
```

Habitat variables:
ECVTR01 : Percent deciduous tree crown cover
GWLTR01 : Stand Width 1- narrow, one tree,2- < 300 ft, 3 - > 300 ft at widest
VHTDE01 : Mean height of deciduous trees (m)

GRAPH FUNCTION at level 2, position 1
Title: Average height deciduous tree canopy (m)

X:	0.000,	Y:	0.000
X:	10.000,	Y:	1.000
X:	15.000,	Y:	1.000

GRAPH FUNCTION at level 2, position 2
Title: % Deciduous tree crown cover

X:	0.000,	Y:	0.000
X:	25.000,	Y:	1.000
X:	50.000,	Y:	1.000
X:	100.000,	Y:	0.750

MENU FUNCTION at level 2, position 3

Menu choice:	1	Output value:	0.200
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	1.000

Comments:
<none>

Library: D:LAMERICN.HLB
6-29-1990

Model # 26 Single covertype model.
Model name: MINK (for. & shr. wetl. <405)
Verification level: EXPERT REVIEW
Creation/modification date: 4-29-1987

FORESTED AND SHRUB WETLANDS < 405 HA (1000 AC) IN SIZE
ALLEN, A. W. 1984. HABITAT SUITABILITY INDEX MODELS: MINK, REVISED.
U.S. FISH WILDL. SERV. BIOL. REP. 82(10.127). 23 PP.
[First printed as: FWS/OBS-82/10.61, October 1983.]
Applies to year-round habitat of forested and shrub wetland populations in wetlands less than 405 ha (1000ac).
Range: throughout the historic range of the species in North America.

Covertypes:
PFO : Palustrine forested wetland
PSS : Palustrine scrub/shrub wetland

```
Lev 3    Lev 2    Lev 1
 VCVTR05--grf------usf--HSI
 TFRDP01--grf-------|
 VCVWO02--grf-------^
```

Habitat variables:
TFRDP01 : Percent of year with surface water present within cover type (%)
VCVTR05 : % canopy cover of trees, shrubs & persistent emergent herbs (%)
VCVWO02 : % canopy cover of trees & shrubs within 100m of wetland's edge (%)

GRAPH FUNCTION at level 2, position 1
Title: % CANOPY CLOSURE

X	Y
0.000	0.000
75.000	1.000
100.000	1.000

GRAPH FUNCTION at level 2, position 2
Title: % OF YEAR WITH SURFACE WATER PRESENT

X	Y
0.000	0.000
25.000	0.000
75.000	1.000
100.000	1.000

GRAPH FUNCTION at level 2, position 3
Title: % CANOPY CLOSURE WITHIN 100 M OF WATER

X	Y
0.000	0.100
75.000	1.000
100.000	1.000

```
USER-SPECIFIED FUNCTION at level 1, position 1
USUB = ((X(1)+X(3))/2)*X(2)
```

Comments:

<none>

Library: D:LAMERICN.HLB
6-29-1990

Model # 27 Single covertype model.
Model name: MINK (herbaceous wetlands)
Verification level: EXPERT REVIEW
Creation/modification date: 4-29-1987

ALLEN, A. W. 1984. HABITAT SUITABILITY INDEX MODELS: MINK, REVISED.
U.S. FISH WILDL. SERV. BIOL. REP. 82(10.127). 23 PP.
[First printed as: FWS/OBS-82/10.61, October 1983.]
Applies to year-round habitat of herbaceous wetland populations.
Range: throughout the historic range of the species in North America.

Covertypes:
PEM : Palustrine emergent wetland
PAB : Palustrine aquatic bed
PML : Palustrine moss/lichen wetland
PUB/ : Palustrine shore & bottom classes (UB/RB/US)

```
Lev 3     Lev 2     Lev 1
TFRDP01--grf------usf--HSI
X61V3----grf-------|
VCVWO02--grf-------^
```

Habitat variables:
TFRDP01 : Percent of year with surface water present within cover type (%)
VCVWO02 : % canopy cover of trees & shrubs within 100m of wetland's edge (%)
X61V3 : % of wetland basin dominated by persist. emerg. herb. veg. (%)

GRAPH FUNCTION at level 2, position 1
Title: % OF YEAR WITH SURFACE WATER PRESENT
X: 0.000, Y: 0.000
X: 25.000, Y: 0.000
X: 75.000, Y: 1.000
X: 100.000, Y: 1.000

GRAPH FUNCTION at level 2, position 2
Title: % DOMINATED BY PERSIS. EMER. HERB. VEGE.
X: 0.000, Y: 0.100
X: 50.000, Y: 1.000
X: 75.000, Y: 1.000
X: 100.000, Y: 0.800

GRAPH FUNCTION at level 2, position 3
Title: % TREE/SHRUB CANOPY CLOSURE 100 M OF H20
X: 0.000, Y: 0.100
X: 75.000, Y: 1.000

```
     X:      100.000,    Y:   1.000


USER-SPECIFIED FUNCTION at level 1, position 1
USUB = (((4*X(2))+X(3))/5)*X(1)


Comments:
     <none>
```

Library: D:LAMERICN.HLB
6-29-1990

Model # 30 Single covertype model.

Model name: SHORT-EARED OWL (Grain & Row)

Verification level: Applied

Creation/modification date: 12-11-1989

Covertypes:

GRAIN : Grain

AC-ROW : Cropland - row crop

```
Lev 5      Lev 4      Lev 3      Lev 2      Lev 1
VHTHE01--grf------gem------prd------min--HSI
VCVHE01--grf-------^        |         |
          GDIHE01--grf-------^         |
          LGRwi01--mnu------prd-------^
          GDIHE02--grf-------^
```

Habitat variables:

GDIHE01 : Distance (km) to herbaceous cover averaging 60 - 90cm tall

GDIHE02 : Distance (km) to herbaceous vegetation 40-75% cover

LGRwi01 : Overwinter cropland management

VCVHE01 : Percent canopy cover of herbs (non-woody plants: grasses & forbs) (%)

VHTHE01 : Mean height of herbaceous canopy (not of individual plants) (cm)

GRAPH FUNCTION at level 4, position 1

Title: Average height herbaceous vegn (cm)

```
X:     0.000,  Y:  0.000
X:    61.000,  Y:  1.000
X:    92.000,  Y:  1.000
X:   152.000,  Y:  0.000
X:   200.000,  Y:  0.000
```

GRAPH FUNCTION at level 4, position 2

Title: Percent herbaceous cover

```
X:     0.000,  Y:  0.000
X:    60.000,  Y:  1.000
X:   100.000,  Y:  1.000
```

GRAPH FUNCTION at level 3, position 2

Title: Distance (km) roost cover (herb 60-90cm)

```
X:     0.000,  Y:  1.000
X:     5.600,  Y:  0.100
X:    10.000,  Y:  0.100
```

MENU FUNCTION at level 3, position 3

Menu choice:	4	Output value:	0.000
Menu choice:	5	Output value:	0.250
Menu choice:	6	Output value:	1.000
Menu choice:	7	Output value:	0.250

GRAPH FUNCTION at level 3, position 4

Title: Distance (km) forage site (40-75% herb)

X:	0.000,	Y:	1.000
X:	5.630,	Y:	0.100
X:	10.000,	Y:	0.100

Comments:

<none>

Library: D:LAMERICN.HLB
6-29-1990

Model # 31 Single covertype model.
Model name: RING-NECKED PHEASANT (Breed)
Verification level: Author Draft
Creation/modification date: 6-29-1989

HABITAT SUITABILITY INDEX MODEL - RING-NECKED PHEASANT (Nest/Brood Cover).
1988. Carolyn B. Mayer, U.S. Fish & Wildlife Service. Pierre, South Dakota.

Covertypes:

AC	:	Cropland
AC-ROW	:	Cropland - row crop
GRAIN	:	Grain
UG	:	Grassland
UF	:	Forbland
UFOD	:	Deciduous Forest
USHD	:	Deciduous shrubland
USSD	:	Deciduous Shrub Savanna
PEMA	:	Palustrine emergent which is temporarily flooded
PEMF	:	Palustrine emergent which is semi-permanently flooded
PSS	:	Palustrine scrub/shrub wetland

```
Lev 3    Lev 2    Lev 1
 EHD01----grf------prd--HSI
 LAPAP02--mnu-------^
```

Habitat variables:

EHD01 : Mean visual obstruction (VOR) (dm)
LAPAP02 : Harvest Practices

GRAPH FUNCTION at level 2, position 1
Title: Mean Visual Obstruction (dm)

X:	0.000,	Y:	0.000
X:	0.500,	Y:	0.100
X:	2.000,	Y:	1.000
X:	20.000,	Y:	1.000

MENU FUNCTION at level 2, position 2

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	0.200
Menu choice:	4	Output value:	0.100

Comments:
LAPAP02
1 - unharvested cover, other than small grains
2 - cover harvested, but not from April 15 - July 15, and is not

small grain
3 - small grain
4 - Cover harvested between April 15 and July 15
Restore AP, and UTSD to covertypes for other studies.

Library: D:AUBURN.HLB
6-29-1990

Model # 33
Model name: TURKEY

Single covertype model.

Verification level: Applied
Creation/modification date: 12-8-1989

PG&E. 1986. Habitat Suitability Index Model Turkey.
Area: western slope Sierra Nevadas. Seasons: year-round. Guilds: feeding - surface, breeding - surface.

Covertypes:
SavGrss : Savanna grassland
BluOakS : Blue Oak savannah

```
  Lev 5      Lev 4      Lev 3      Lev 2      Lev 1
   FSS01----mnu------usf------gem------prd--HSI
            FSS01-----|          |          |
   VCVTR01--hst-------^          |          |
   ECVOak1--grf------mea---------^          |
   VCVGR01--grf-------|                     |
   VCVGR01--grf-------^                     |
                      LAPGz01--mnu----------^
```

Habitat variables:
ECVOak1 : Percent canopy cover of oaks
FSS01 : Successional stage of tree and/or chaparral areas
LAPGz01 : Livestock use
VCVGR01 : Percent canopy cover of grasses (%)
VCVTR01 : Percent canopy cover of trees (%)

MENU FUNCTION at level 4, position 1

Menu choice:	1	Output value:	0.600
Menu choice:	2	Output value:	0.400
Menu choice:	3	Output value:	0.300
Menu choice:	4	Output value:	0.400

HISTOGRAM FUNCTION at level 4, position 3

0.000	<=	39.000	=	0.700
39.000	<=	69.000	=	0.400
69.000	<=	100.000	=	0.000

GRAPH FUNCTION at level 4, position 4
Title: % Oak canopy cover

X:	0.000,	Y:	0.000
X:	15.000,	Y:	1.000
X:	40.000,	Y:	1.000

```
     X:      55.000,    Y:   0.700
     X:      60.000,    Y:   0.500
     X:      70.000,    Y:   0.000
     X:     100.000,    Y:   0.000

GRAPH FUNCTION at level 4, position 5
  Title:  % GRASS COVER
     X:       0.000,    Y:   0.000
     X:      40.000,    Y:   1.000
     X:     100.000,    Y:   1.000

GRAPH FUNCTION at level 4, position 6
  Title:  % GRASS COVER
     X:       0.000,    Y:   0.000
     X:      40.000,    Y:   1.000
     X:     100.000,    Y:   1.000

USER-SPECIFIED FUNCTION at level 3, position 1
IF X(3) = 0 THEN USUB = 0
IF X(2) = 1 OR X(2) = 2 THEN USUB = X(1) ELSE USUB = X(1) + X(3)
IF X(1) + X(3) > 1.0 THEN USUB = 1.0

MENU FUNCTION at level 2, position 2
     Menu choice:      1     Output value:   0.600
     Menu choice:      2     Output value:   1.000

Comments:
     <none>
```

APPENDIX D

SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF ALAMEDA

---oOo---

ENVIRONMENTAL DEFENSE FUND, INC., et al.,

Plaintiff,

vs.

No. 425955

EAST BAY MUNICIPAL UTILITY DISTRICT, et al.,

Defendants.

COUNTY OF SACRAMENTO, et al.,

Intervenors.

PRELIMINARY TENTATIVE DECISION

---oOo---

I.

The single issue, which has spawned 17 years of litigation to date, is whether, pursuant to a 1970 contract with the Bureau of Reclamation, EBMUD may divert 150,000 acre-feet annually (AFA) from the Folsom Reservoir at the Folsom-South Canal or whether the mandates of Article 10, Section 2 of the California Constitution and public trust doctrine require that the diversion occur

with confidence that the alternatives proposed by plaintiffs and intervenors herein are neither realistic nor "feasible".

Adopting the board's approach and following well-established judicial precedent, this Court will impose a physical solution as a means of accommodating the diverse and conflicting interests which have been addressed. The ultimate objective is to provide for the fullest beneficial use of the water under Article 10, Section 2, and at the same time, to protect the sensitive public trust values of the Lower American River.

It should perhaps be noted that the board's deliberations and conclusions were circumscribed by its concern about the absence of the Bureau of Reclamation as a party. While the board's absence did deprive the proceedings of a certain desired symmetry, it is the view of the Court that the physical solution presented here is a mandate of Article 10, Section 2, in conjunction with public trust doctrine, and represents an absolute condition of diversion by EBMUD.

Physical Solution shall be accomplished as follows:

1. EBMUD may divert 150,000 acre-feet annually (AFA) from the Folsom-South Canal pursuant to the contract of December 22nd, 1970.

2. The following instream flow requirements must be met as a condition of the diversion:

A. October 15th through February, 2000

CFS;

B. March through June, 3000 CFS;

C. July through October 15th, 1750 CFS;

3. Additionally, 60,000 AFA will be maintained in reserve from mid-October through June for release in accordance with the recommendations of the Department of Fish and Game in response to specific fishery needs.

4. EBMUD shall use its best efforts to divert as much water as possible during those times when instream flows are least required for protection of environmental interests.

5. During such periods when flow requirements physically cannot be met, defendant may not divert any part of its appropriation.

6. Defendants shall not divert water except to meet the demands of customers within the EBMUD utility district.

7. EBMUD shall not market nor sell its water to any third party, particularly agricultural interests.(1)

8. EBMUD shall contribute to the cost of maintaining a viable fishery and riparian habitat in the Lower American River.

The foregoing flow regimen is not merely "interim" in nature. It is intended as a permanent,

---

(1) Water quality was the "weight" placed in the balance on behalf of EMBUD; no balancing of agricultural or other interests was considered by the Court.

constitutionally mandated prerequisite to diversion, [redacted] only upon the presentation of convincing [redacted] the diversion, singly or in combination with other diversions and appropriations, is causing legally cognizable damage to the public trust values identified in this case.

9. The Court will appoint a special master to monitor the physical solution upon terms and conditions to be agreed upon by the parties.

Relief is granted on the pleadings in accordance with the foregoing opinion.

---o0o---

Dated: May 31, 1989

RICHARD A. HODGE, JUDGE
of the Superior Court

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

AMERICAN RIVER WATERSHED INVESTIGATION

NATOMAS AREA

SUBSTANTIATING REPORT

VOLUME IV

REGION ONE

NOVEMBER 1991

Substantiating

Report

Natomas Area

NOVEMBER 1991

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DESCRIPTION OF AREA

Features of the project described in this report are found within what we have termed the Natomas Area. The project boundaries shown in Figure 1 are for purposes of project description and do not represent those of any political or legal entities. The project bounds include portions of Sacramento and Sutter Counties. The Sutter County segment is bounded on the north by the Natomas Cross Canal, south by Sutter/Sacramento County line, east by the Natomas East Main Drainage Canal (NEMDC) and west by the Sacramento River. The Sutter County segment comprises about 17,000 acres. The Sacramento County segment is bounded on the north by the Sutter/Sacramento County line, south and east by the NEMDC, and west by the Sacramento River. The Sacramento County segment comprises about 38,000 acres. The Sacramento County segment is divided into subareas that are under city of Sacramento jurisdiction and county jurisdiction. These areas are North Sacramento County, Sacramento Airport, Special Planning Area, and North Natomas and South Natomas communities. The following information is excerpted from general and community plans prepared by the City and County of Sacramento for the urbanized area and areas proposed for urbanization.

Political and community plan boundaries are shown in Figure 2. The community of South Natomas encompasses about 7.7 square miles (3,500 acres). It is bounded by Interstate Highway 80 on the west and north, the American River on the south, and the NEMDC to the east. Although South Natomas is situated at the northern edge of the highly urbanized city of Sacramento, about 32 percent (1,120 acres) of the area remains in agriculture. Future plans call for rapid commercial and residential development with most agricultural lands being converted to urban uses. Few natural areas will remain. Less than 10 percent of the available land use acreage is designated for neighborhood, community and city parkways (City of Sacramento, 1987).

The North Natomas Community Planning Area, including future extensions, is bounded on the west by the Sacramento River, the south by Interstate Highway 80, the north by Elkhorn Blvd., and on the east by the NEMDC (City of Sacramento 1985, 1986). The planning area is comprised of approximately 9,300 acres located within the City and County of Sacramento. Including all drainageways and roadways, as well as land parcels, the site includes 7,778 acres within the City and 1,577 acres within the County. The primary land use within the area is agriculture with a high percentage of the area held by a few land owners. Numerous agricultural drainage canals and levee toe drains convey water in all directions. Riparian vegetation, open waters, flooded rice fields and roadway ditches contribute to the

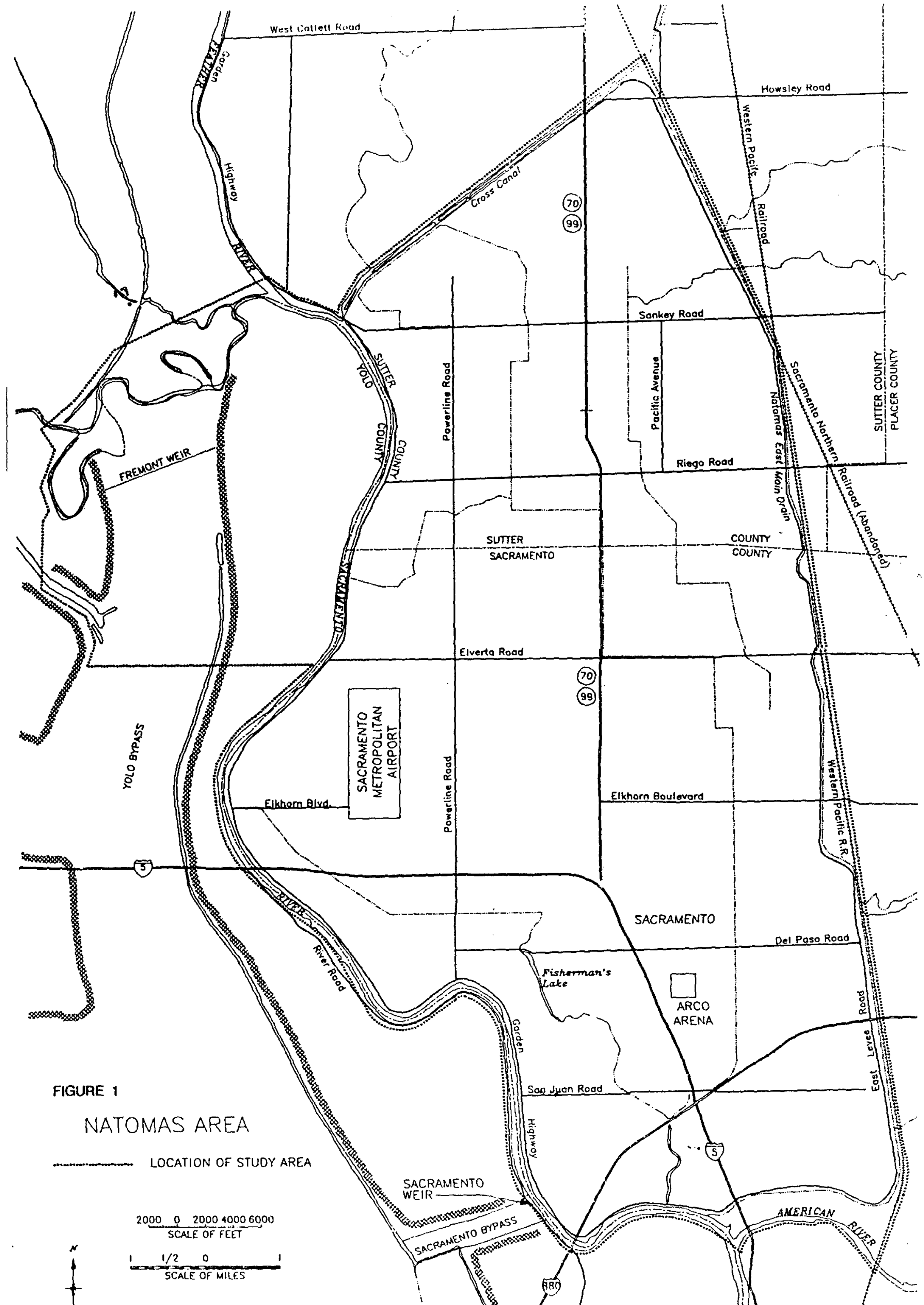

FIGURE 1

NATOMAS AREA

LOCATION OF STUDY AREA

SUTTER COUNTY
PLACER COUNTY
Sacramento Northern Railroad (Abandoned)
Howsley Road
Western Pacifc Railroad
West Catlett Road
Garden Highway
FEATHER RIVER
YOLO COUNTY
SACRAMENTO
FREMONT WEIR

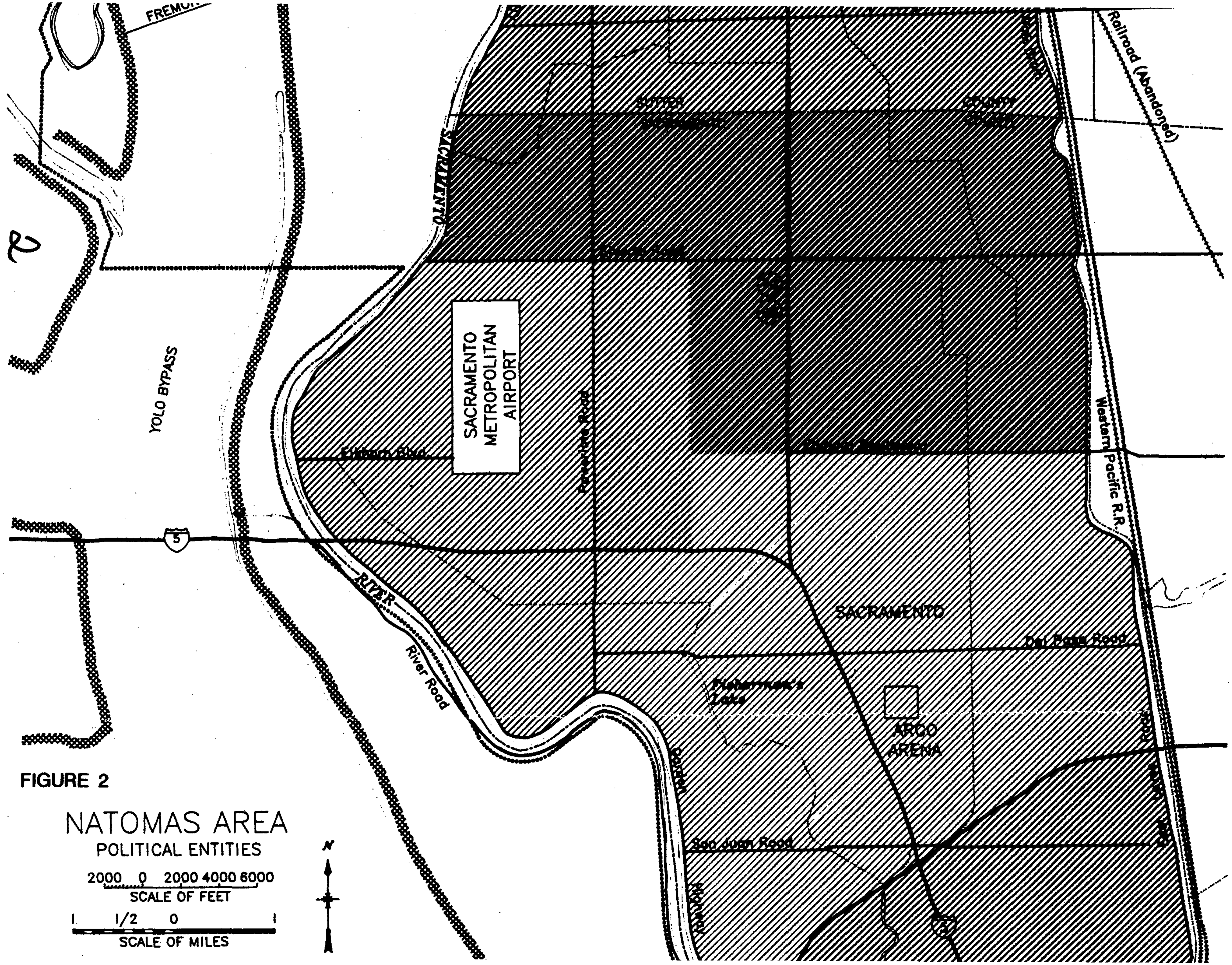

FIGURE 2

NATOMAS AREA
POLITICAL ENTITIES

2000 0 2000 4000 6000
SCALE OF FEET

1 1/2 0 1
SCALE OF MILES

3

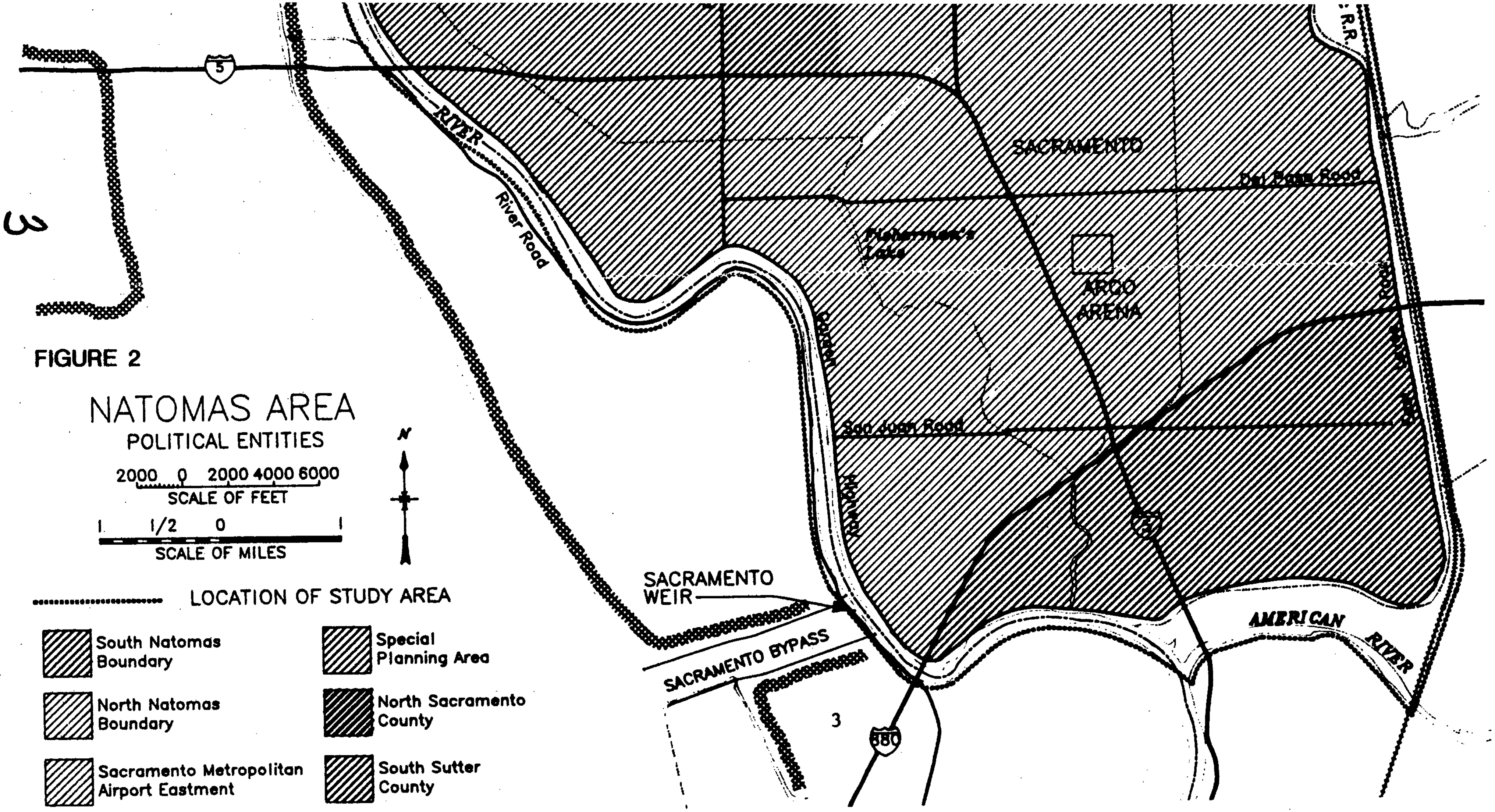

FIGURE 2
NATOMAS AREA
POLITICAL ENTITIES
2000 0 2000 4000 6000
SCALE OF FEET
1 1/2 0 1
SCALE OF MILES
N
LOCATION OF STUDY AREA
South Natomas Boundary
North Natomas Boundary
Sacramento Metropolitan Airport Eastment
Special Planning Area
North Sacramento County
South Sutter County
5
RIVER
River Road
SACRAMENTO
Del Paso Road
ARCO ARENA
San Juan Road
Garden Highway
SACRAMENTO WEIR
SACRAMENTO BYPASS
3
880
AMERICAN RIVER
R.R.

wildlife habitat diversity in North Natomas. Future plans call for 85 percent of the lands to be developed for industrial, commercial, residential and civic/public use. About 15 percent would be set aside for parks, greenbelts, buffers and drainages.

The Sacramento Metropolitan Airport now occupies about 6,600 acres and is bounded by Powerline Road on the east, Elverta Road on the north, Sacramento River on the west, and extends slightly south of Interstate 5. At planned ultimate buildout, it will occupy about 7,800 acres in North Natomas and a small segment in south Sutter County. Of the 7,800 acres, about 6,700 acres (86%) are in some form of agriculture. About 450 acres (6%) of uncultivated vegetation lies along roadways, powerlines, fences and waterways, about 145 acres (2%) are uncultivated fields, and about 80 acres (1%) are riparian type habitat. Future airport plans call for the conversion of about 3,200 acres (33%) of the agriculture lands to airport structures and paved areas, and about 150 acres (33%) of the linear vegetation and associated waterways will also be lost (County of Sacramento, 1976).

The North Sacramento County and South Sutter County portion of the Natomas Area is bounded on the east by the NEMDC and Pleasant Grove Creek Canal, on the north by Natomas Cross Canal, on the west by Sacramento River, and on the south by Elverta Road and Elkhorn Boulevard. Land use in this part of the area is predominantly agriculture and open space; only about 10 percent has been developed for residential, commercial, industrial and public uses.

Overall, most of the land within project bounds is in agriculture, except for South Natomas where 57 percent is in urban development.

PROJECT ALTERNATIVES

Each of the six action alternatives for the Natomas area involves raising the height of levees, at various locations, from about 1 foot to 10 feet depending on the alternative under consideration. Other features common to all alternatives include excavation of a drainage channel from Riego Road to Sankey Road, a pump station, ramping of roadways over levees, bridge relocation, a borrow/spoil site, and relocation of fencing and utility lines. A detention basin is an additional feature of the 200-year and 400-year alternatives.

Construction of the selected plan (200-year alternative; Figure 3) would require the following actions:

1. Raising 1.3 miles of the east NEMDC levee 1.0 foot from Arcade Creek to Dry Creek.

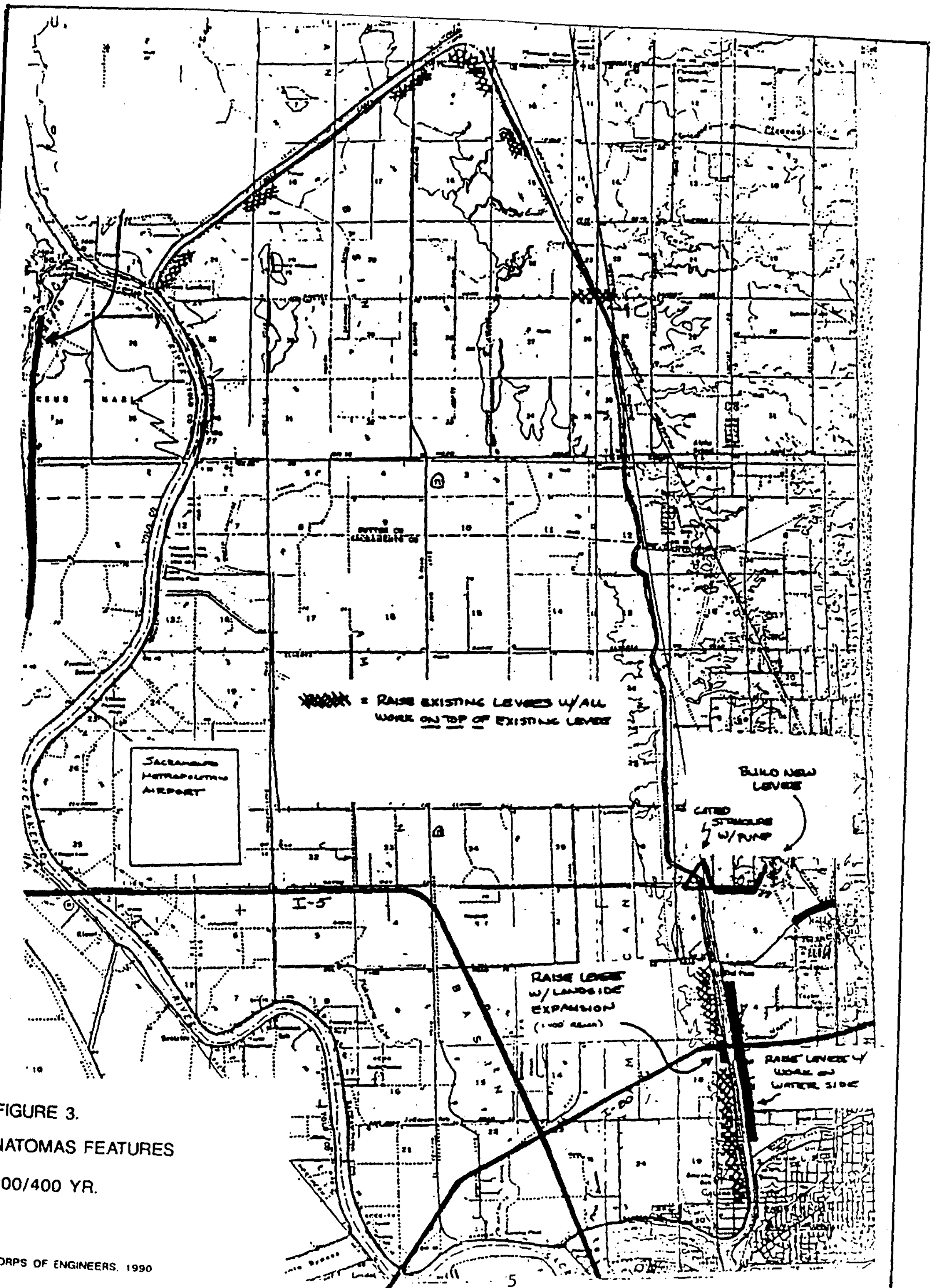

FIGURE 3.
NATOMAS FEATURES
200/400 YR.

CORPS OF ENGINEERS, 1990

2. Raising 2.5 miles of the west NEMDC levee 2.0 feet from El Camino Road to Main Street, and 0.6 mile of the levee 1.1 feet from Riego Road to Sankey Road.

3. Replacing Main Avenue bridge.

4. Ramping Sankey Road.

5. Constructing a 2-mile-long, 3,000 cfs drainage channel from Riego Road to Sankey Road.

6. Constructing a 700 cfs-capacity pump station in the NEMDC just upstream from the mouth of Dry Creek.

7. Raising, at various locations, 0.4 mile of the north Arcade Creek levee 3.1 feet, and installing 1,000 feet of fence.

8. Raising, at various locations, 0.2 mile of the south Arcade Creek levee 1.3 feet, and installing 1,300 feet of fence and 600 feet of powerline.

9. Raising, at various locations, 0.9 miles of the new north Dry Creek levee 8.3 feet.

10. Ramping Ascott Avenue and installing 200 feet of fence.

11. Raising, at various locations, 0.2 mile of the south Dry Creek levee 0.7 foot.

12. Extending the south Dry Creek levee 0.4 mile at a height of 4.8 feet.

13. Raising, at various locations, 0.1 mile of the Pleasant Grove Creek Canal levee 1.8 feet.

14. Ramping Howsley Road and relocating 1,000 feet of power and telephone line.

15. Raising, at various locations, 1.1 miles of Natomas Cross Canal levee 1.6 feet.

16. Ramping Highway 99.

17. Establishing a 125-acre borrow/spoil site near Garden Highway and Powerline Road.

18. Establishing a floodwater detention basin in the northeast corner of the Natomas Area by enclosing 308 acres of agricultural land with a levee.

Recreational features included in the selected plan, as in all alternative plans, are as follows:

1. Paved pedestrian/biking trails and parallel unpaved equestrian trails along portions of the NEMDC and Dry and Arcade Creeks, with access and sanitation facilities.

2. Six hundred shade trees along the trail, and picnic sites and sanitation and water facilities in or near existing parks.

3. A complex of intensive day-use recreational facilities, river access points, and passive-use wildlife habitat restoration areas near the mouth of the NEMDC and the Erruttia property in the American River Parkway.

4. Rerouting 1.1 miles of bike trail to avoid a surface crossing of Del Paso Boulevard.

Mitigation of direct project impacts on wildlife habitat would be accomplished through the acquisition and development of 280 acres of agricultural land near Elverta Road west of the NEMDC. The area would be managed as a wetland/upland complex consisting of 134 acres of wetland and 146 acres of upland.

EXISTING CONDITIONS

VEGETATION

As a result of lying in the historical floodplain of the southern American Basin, the Sacramento County and south Sutter County portions of the Natomas Area (Figure 4) contain large expanses of fertile alluvial soils. Based on information obtained from the Corps of Engineers, we understand that the U.S. Soil Conservation Service mapped over 21,400 acres of prime and unique soils in Sacramento County and 2,600 acres in south Sutter County within the Natomas Area. Approximate distribution of soil types taken from SCS maps of Sacramento and Sutter Counties is displayed on a map in Appendix G.

About 80 percent of land use in Natomas remains in agriculture. Most of the alfalfa, orchard, row and truck crops are grown adjacent to and landside of the levees on soils with suitable permeability and drainage. Rice, dry grains, sorghum and corn are grown, for the most part, on interior lands having poorer drainage. Further discussion on agriculture appears later in this section.

FIGURE 4 NATOMAS AREA

1 -SOUTH NATOMAS

2 -NORTH NATOMAS

3 -SACRAMENTO RIVER

4 -NATOMAS CROSS CANAL

5 -NATOMAS EAST MAIN DRAIN

6 -LOWER AMERICAN RIVER

The South Natomas area (Figure 4), which occupies the extreme southern edge of the Natomas Area abutting the levees of the American and Sacramento Rivers, is the most intensively urbanized segment of the area. This area features large office buildings, dense residential developments, and commercial businesses. Nonetheless, agricultural land comprises 32 percent of the South Natomas area (City of Sacramento, 1988). The small amount of natural open space that exists occurs either adjoining the agricultural lands, as remnant sites along drainage canals and channels, or as a few acres of planned open space along Bannon Slough (the only remaining natural drainage in the area). With the exception of localized commercial development associated with the ARCO Arena and Sacramento Metropolitan Airport, the developed portions of the Natomas Area, excluding South Natomas, consist mainly of small farms and several upscale waterfront homes along the Garden Highway and the network of roadways, and Interstates 5 and 80. These areas have landscape plantings.

Except for shaded riverine aquatic (Appendix D), the following natural and uncultivated vegetation types in the Natomas Area were described by Jones and Stokes (City of Sacramento, 1988). The habitat types generally describe most of the project area. The natural and uncultivated vegetation types of the Natomas Area include the following: open water aquatic; freshwater marsh; riparian scrub-shrub; valley riparian forest (which includes three subcategories: young willow-cottonwood forest, mixed riparian forest, and valley oak riparian forest); valley oak woodland, grassland; fallow old fields; and shaded riverine aquatic.

For purposes of our Habitat Evaluation Procedures (HEP) analysis, we identified the combined acreages of emergent marsh, open water, palustrine forest and palustrine scrub-shrub as wetland acreage. It is important to recognize that the wetland cover acreages used in the HEP analysis are much greater than the approximately 380 acres of jurisdictional wetlands subject to section 404 of the Clean Water Act, as identified by the Corps of Engineers in September 1990 (Figure 5). HEP wetlands were afforded a much broader definition based on observed wildlife habitat values. Thus, many of the agricultural canals, ditches and waterways not meeting jurisdictional wetland criteria remain within our wetland cover acreages. We also identified the combined acreages of rice, grain, pasture, grassland, orchard and row crops as upland acreage. Acreages of cover types under existing conditions are shown in Table 1.

<u>Open Water Aquatic Habitat</u>

Open water aquatic habitat occurs within slow-moving water courses such as sloughs, canals and ditches that have a

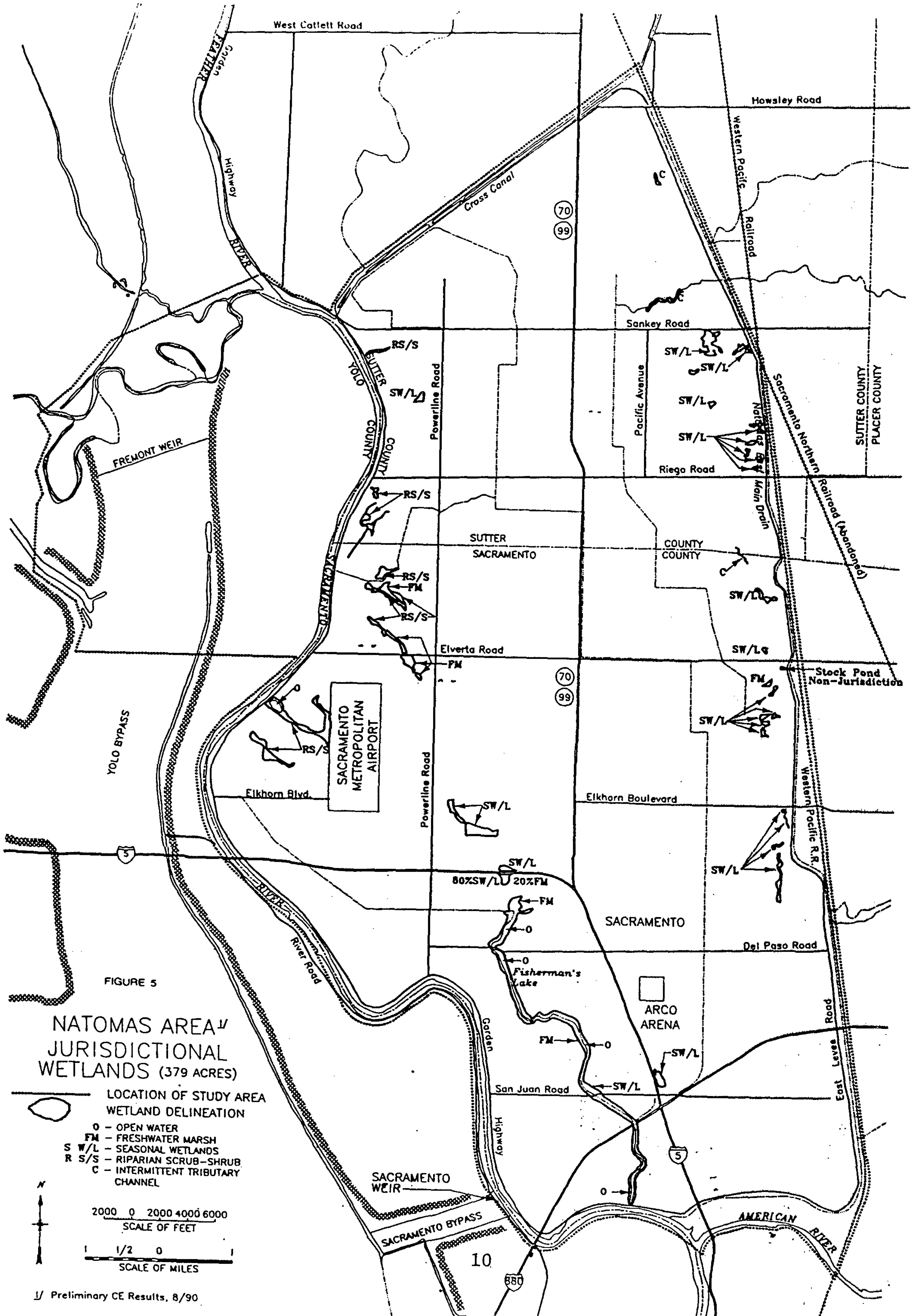

FIGURE 5

NATOMAS AREA[1/] JURISDICTIONAL WETLANDS (379 ACRES)

LOCATION OF STUDY AREA

WETLAND DELINEATION

- O – OPEN WATER
- FM – FRESHWATER MARSH
- SW/L – SEASONAL WETLANDS
- RS/S – RIPARIAN SCRUB-SHRUB
- C – INTERMITTENT TRIBUTARY CHANNEL

N

2000 0 2000 4000 6000
SCALE OF FEET

1 1/2 0 1
SCALE OF MILES

1/ Preliminary CE Results, 8/90

Table 1. Acres of Wildlife Cover Types (Existing Conditions)

Wetland Cover Types	Acres
Marsh	760
Riparian forest	12
Scrub-shrub	633
Subtotal	1,405
Upland Cover Types	
Rice	12,936
Grain	10,371
Pasture	1,139
Grassland	2,895
Orchard	1,034
Row crop	11,628
Subtotal	40,003
Total	41,408

relatively consistent water depth and do not dry seasonally (Figure 6). Although open water habitats are usually associated with freshwater marshes, they technically begin where rooted emergent species such as cattails and tules end, typically in water depths greater than 5 feet. These open water habitats support submergent aquatic vegetation including species such as pondweeds, duckweeds, elodea, water milfoil, water primrose, yellow water weed, and smartweed. In some areas, such as Fisherman's Lake and portions of the NEMDC, this habitat type includes large open water ponds.

Freshwater Marsh

This habitat occurs in association with the ponds, sloughs, canals and waterways of the Natomas Area where water depths do not exceed 5 feet for prolonged periods. The marshes of the study area typically consist of narrow bands along the sloughs, channels, and drainage ditches that run throughout the area. Tules and cattails typify freshwater marsh habitats but other water-margin associates include smartweed, rushes, sedges, water plantain, and vervain on the upper margins (Figure 7).

Riparian Scrub-Shrub

This woody, shrub-dominated habitat is frequently associated with marsh and other perennial wetland habitats along the bypasses, canals, channels, and streams in the Natomas Area (Figure 8).

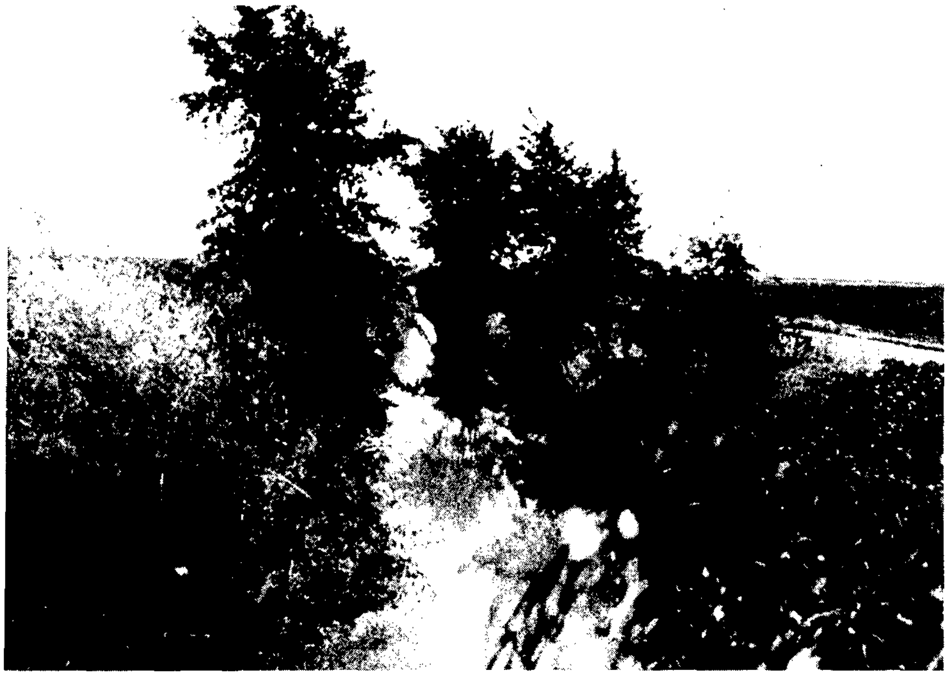

Figure 6 Open Water.

Figure 7 Palustrine Emergent Marsh.

FIGURE 8 RIPARIAN SCRUB-SHRUB

FIGURE 9. RIPARIAN FOREST-YOUNG COTTONWOOD/WILLOW

Most of the canals, sloughs, ponds and channels of the area support small, mostly linear patches of riparian scrub-shrub vegetation. It is characterized by various woody shrubs including shrub willows, berry vines, poison oak, wild rose, elderberry, buttonwillow, and some seedling and sapling trees such as oak, walnut, cottonwood, willows, and box elder. Herbaceous associates include many aggressive forbs and grasses including brome, oat, and barley grasses, barnyard grass, ryegrass, wild mustard, horseweed, ambrosia, thistle, sweet fennel, dock, knot weed, and lippea.

Scrub-shrub habitat is largely transitional and, if given sufficient time (approximately 5 or more years), would eventually develop into a forest or woodland habitat type. However, periodic disturbances associated with levee, canal, and channel maintenance (mowing, discing, burning, and spraying) prevent the vegetation from developing past the scrub-shrub stage. This habitat also is often similar to and associated with ruderal upland habitats because of comparable disturbance and species composition.

<u>Valley Riparian Forest</u>

Riparian forest habitats in the Natomas Area include sites that either have never been cleared (remnant stands), or altered sites where human disturbance has not prevented (either purposely or incidentally) the maturation of woody vegetation. Although several "phases" of riparian forest habitat may be recognized, including young-growth willow-cottonwood forest, mixed riparian forest, and valley oak riparian forest (City of Sacramento, 1988) only one "type", palustrine forest (PFO), was used in the wildlife habitat evaluation analysis. However, these three riparian forest "phases" appear to be successional stages in the natural maturation and progression of the riparian forest toward the oldest community phase of valley oak woodland and/or savanna habitat. Virtually all stands of the palustrine forest occur along the levees, channels, and canals of the Natomas Area and along the banks of the American and Sacramento Rivers. Consequently, in all but a few instances, the stands consist of linear bands of forest varying from a few yards wide to several hundred feet.

The earliest stage of the riparian forest consists of the <u>young-growth willow-cottonwood forest</u> (Figure 9). This cover type occurs along river, stream and channel banks and in lowland sites where flooding is frequent (usually annual) but where soil typically becomes seasonally exposed. This cover type can be found along the Natomas Cross Canal and at localized sites along the Sacramento River and channel and canal outfalls. As shown in Figure 10, this habitat typically consists of dense stands of

sapling and pole stage (generally 1" to 5" diameter) willows and cottonwoods that attain heights of 20 to 40 feet. Canopy closure varies from greater than 50 percent to nearly 100 percent. An occasional understory of box elder and buttonbush may be present. The sparse to dense herb layer may be composed of weedy grasses, cocklebur, smartweed, grape, and sedges, but often the soil is bare or covered only by leaf litter.

The mixed riparian forest cover type occurs on upland sites along the canals, channels, streams and rivers of the Natomas area where human disturbance such as burning, discing, and clearing is minimal or absent. In these sites, the vegetation often has matured to a stage where a multi-layered, dense canopy has developed and the willows and cottonwoods have attained heights of 40 to 100 feet. Overstory dominants include mature to scenescent cottonwoods and willows with minor representation of valley oak (Figure 10). There is typically a well-developed midstory of shrub and tree willows, boxelder, young valley oaks (especially in ecotonal and gap areas) and dense, draping vines of grape, blackberry and poison oak. Areas lacking a tree overstory are few and mainly consist of small openings within the surrounding forest that support dense shrub thickets of willows, young oaks, vines, an occasional elderberry, and a dense herb layer.

This mixed forest varies greatly in composition and structure, probably as a consequence of site-to-site differences in dynamic riverine processes of winter flooding, sediment deposition, and erosion. Consequently, stands along the Sacramento and American Rivers and Yolo Bypass differ noticeably from those of the interior of Natomas. The Natomas stands generally are structurally and compositionally less diverse, less variable in age and height, and generally of smaller areal extent.

Stands of the mixed riparian forest cover type can be found along the water side of the levees of the Sacramento River, within the levees along the NEMDC, along the edges of Fisherman's Lake, the Natomas Cross Canal, and the drainages and sloughs of the Yolo Bypass.

Valley oak riparian forest represents the oldest stage of the riparian forest type (Figure 11). Stands of this cover type typically occupy the least-disturbed, relatively level terraces adjacent to the Sacramento River, mainly on the water side of the Sacramento River east levee. However, a few small, relic stands exist along and adjacent to both sides of the west levee and on the land side of the east levee.

FIGURE 10. RIPARIAN FOREST MIXED

FIGURE 11 VALLEY OAK RIPARIAN

The valley oak riparian forest consists of dense canopy forest dominated by valley oak and, to a lesser extent, cottonwood trees that exceed 100 feet in height. Many of the overstory trees are massive old survivors, but frequently younger mature individuals may be interspersed. The midstory consists of mixed stands of willows, sapling oaks, Oregon ash, walnut, and an occasional naturalized or planted ornamental such as fig, tree of heaven, or locust. Mature sycamores occur but rarely cover more than 1000-2000 square meters (1/4 to 1/2 acre). Vines of wild grape, poison oak, and blackberry frequently cover the midstory trees and shrubs. The understory shrub layer often consists of dense thickets of wild rose, poison oak, blackberry, scattered elderberry, and seedling and sapling trees. Dense carpets of grasses and forbs commonly occur in open patches between the woody shrubs and consist of many of the same species found in the scrub-shrub sites.

Valley Oak Woodland

In several scattered locations throughout the study area, mainly adjacent to the Sacramento River and American River levees, the forest vegetation has matured past the riparian forest condition and now exists as woodland. This cover (Figure 12) type consists of a largely two-layered community dominated by valley oak with an open tree overstory, but canopy cover typically greater than 30 percent. Associated native trees include an occasional cottonwood, infrequent tree willows, and rarely one or two sycamores. The ground cover is dominated by herbaceous, largely ruderal grasses and forbs. A shrub layer is virtually nonexistent except for an occasional elderberry, wild rose, poison oak shrub, coyote bush, or berry vine.

Grassland

In areas where tree cover drops below 30 percent and ground cover consists mainly of grasses and forbs, the community is considered a savanna-grassland (Figure 13). Grassland species, which now consist mainly of naturalized European annuals, occur ubiquitously throughout the Natomas area. Although grassland is considered a distinct cover type, it exists as the most common ground vegetation within virtually all of the other terrestrial cover types. Only in well-drained areas of low tree and shrub cover does grassland become the apparent dominant. The most common grass species include wild oats, slender wild oats, softchess, rip-gut brome, Bermuda grass, annual and perennial ryegrass, dog tail grass, dallis grass, and hairgrass. Common forbs include clover spp., vetch, star thistle, plantain, dove weed, bur clover, storks bill, horseweed, wild lettuce, telegraph weed, and many other less common herbaceous species. Grassland is the common vegetation of the levees throughout the area. It

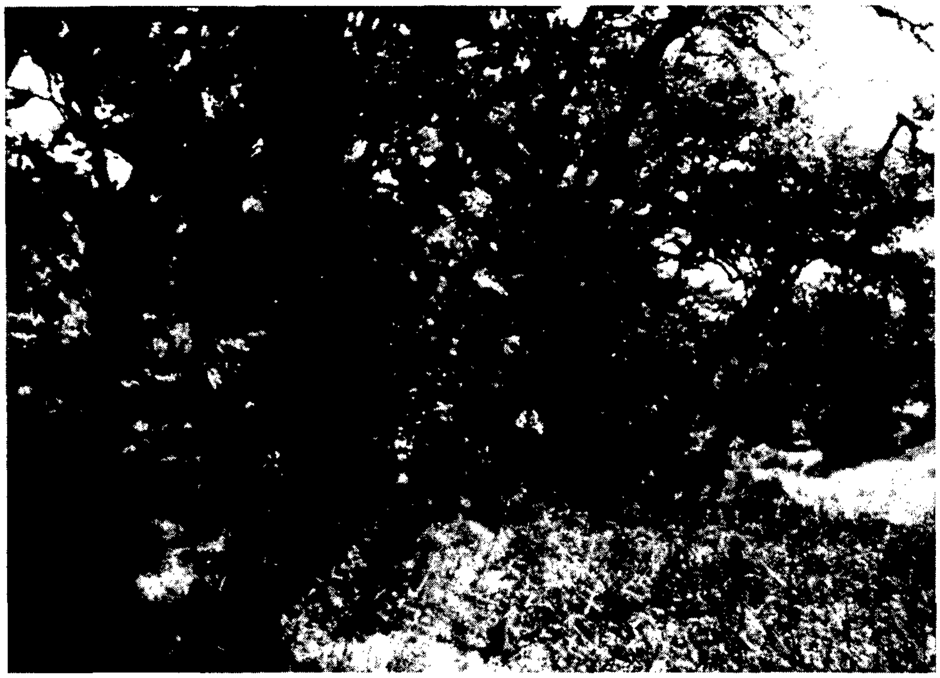

FIGURE 12 VALLEY OAK-WOODLAND

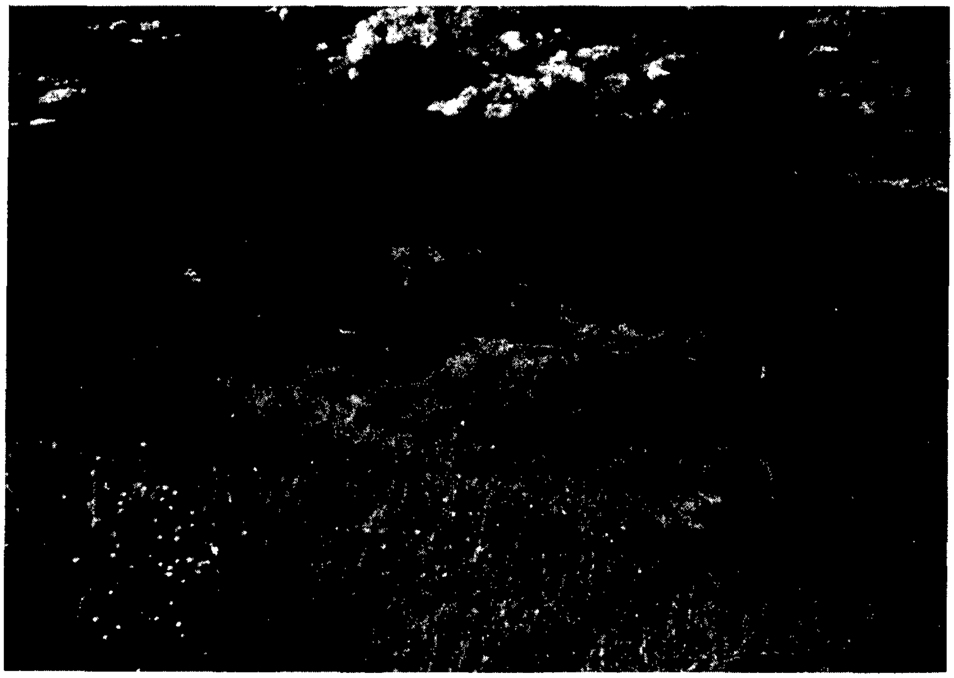

FIGURE 13 GRASSLAND

occurs along road shoulders and easements and powerline rights-of-way.

Oldfield Habitat

Although oldfield is considered a habitat type separate from grassland, the species composition is virtually identical to the grassland described above. An oldfield technically begins forming when cultivation ceases. Typically, a ruderal grass/forb cover develops shortly after discing stops (Figure 14). The eventual mature vegetation of a given oldfield, however, will depend upon a number of conditions including, but not limited, to drainage conditions, soil type, nearby vegetation, and disturbance regime (e.g., grazing, trampling, mowing, fire). Oldfields in the Natomas area typically are abandoned agricultural fields or those that have been left fallow for at least one year.

Shaded Riverine Aquatic

Shaded riverine aquatic habitat is a unique aquatic zone which occurs where riparian vegetation overhangs and protrudes into a stream or river channel (Figure 15). Shaded riverine aquatic habitat is characterized mainly by the shade it receives from the overhanging vegetation, but other unique attributes, one or more of which are usually present, are: (1) living roots, branches, and tree trunks exposed within the water; (2) fallen plant material, including logs, branches, and leaves within the water; (3) relatively irregular and uneven natural banks, often with many depressions, cavities, and crevices; (4) comparatively shallow, low-velocity areas near the shoreline; (5) more detritus and greater primary food-chain production than nearby unshaded areas; and (6) lower water temperatures than comparable unshaded nearshore areas.

Intensive agriculture is practiced on most of the lands in the project area. Therefore, the type of vegetation present on a given parcel varies greatly throughout the crop year. In some areas two row crops may be harvested per year. Thus, for purposes of estimating the existing vegetation cover within the proposed flood-protected area, the Service conducted a cursory survey of cropping patterns in August 1990 in Sacramento and Sutter Counties. In addition, we contacted the local Soil Conservation Service agent and requested information on major crop planting and harvesting schedules. Results of the survey and SCS information are provided in Table 2 and Appendix G.

East of the Sacramento River levees, in the extensive Natomas interior, large fields of rice, dryland grains and pasture occur. There is an interspersion of several other lesser crop types

FIGURE 14 OLDFIELD

FIGURE 15 SHADED RIVERINE AQUATIC

Table 2. Acreage, planting and harvest schedules for major crops in Sacramento and Sutter Counties in the flood-protected project area.

Crop	Sacramento County (Acres)	Sutter County (Acres)	Planting	Harvest
Rice	9620	14017	May (1st-middle)	Oct/Nov (depending on rain)
Wheat	3056	1268	Nov-Dec (weather dependent)	July (after 4th)
Sugar Beets	2510	1099	Fall-Dec Spring-April/May	Fall-Sep Spring-March/April
Safflower	2019	634	Feb/March	August
Corn	1995	458	April/May	Sep/Oct
Tomatoes	1124	124	As early as weather will allow--Jan/Feb/March	August
Alfalfa	830	152	Fall-Sep thru Oct	April-Oct

(e.g., orchards, vineyards, row crops) and localized small urban/residential developments.

Ruderal uplands and fallow oldfields occur in the agricultural interior of Natomas. They vary in size, and location depending upon prevailing agricultural practices. Palustrine emergent marsh exists in the Natomas Area largely as a man-made feature associated with the agricultural uses in the area. Because of the large acreages of rice and the numerous associated drainage canals and sloughs, marsh and open water associated species occur throughout the Natomas area. The expansive networks of rice checks, canals and sloughs, which typically support tall stands of bullrush, cattails and other dense emergent marsh plants, provide excellent cover for numerous natural freshwater marsh wildlife species. The Fisherman's Lake and associated First Bannon Slough areas are particularly significant freshwater marsh sites.

<u>Sacramento River--American River Mouth to Natomas Cross Canal Mouth</u>

Grassland cover dominates much of the landside levee berms and crowns on both sides of the Sacramento River in this reach. Grasses and forbs interspersed with scrub-shrub vegetation have low to moderate wildlife habitat value due to levee maintenance practices of mowing and burning.

Palustrine forest and palustrine scrub-shrub habitat occur in dense to intermittent bands along the waterside of the levee on both sides of this reach of the Sacramento River. The forest and scrub-shrub, with its high productivity and diversity of tree, shrub and forbs provides abundant fruits, seeds, nectar, and forage for wildlife species.

<u>Natomas Cross Canal--Sacramento River to Confluence with NEMDC</u>

The cover-type along the waterside slopes of the south levee of the Natomas Cross Canal is predominantly upland grasses with a few relatively small areas of riparian scrub-shrub (mostly willows and oaks). Low habitat values prevail due to annual burning by the managing levee district.

The landside levee slopes of the south levee of the Cross Canal are very similar in cover types and habitat types to the waterside levee slopes. A toe drain exists at the base of the landside levee slope and parallels most of the length of the south levee. The toe drain ranges from about 8 to 25 feet in width and up to several feet in depth. Because much of the toe drain is only periodically flooded, emergent marsh, indicated by dense thickets of cattails and bulrush, occurs sporadically along the drain.

Natomas East Main Drainage Canal

Except for one additional cover-type, palustrine open water, the NEMDC has the same basic cover types as the Natomas Cross Canal. However, the composition of the cover-types and general habitat values of the NEMDC vary substantially in the various reaches. In general, similar species occur when the vegetative cover is present but they are fewer in number and less likely to be observed. All habitat is degraded compared to the Natomas Cross Canal due to intermittent water supply, reduced water quality, lack of care and maintenance, illegal fill, extensive trampling and soil compaction by people and vehicles, and other damaging actions. The following five ecologically distinct reaches can be recognized: (1) Howsely Road to Pleasant Grove Creek, a distance of about 2 miles; (2) Pleasant Grove Creek to Sankey Road, about 1.3 miles; (3) Sankey Road to Interstate Highway 80, about 9.3 miles; (4) Interstate Highway 80 to Arcade Creek, about 1.5 miles; and (5) Arcade Creek to the American River, a distance of 3.4 miles.

Howsley Road to Pleasant Grove Creek. One small area is covered by young, low-diversity riparian forest. Open water areas include both palustrine open water and riverine open water. Scrub-shrub and emergent marsh cover types are present. The few scrub-shrub areas are composed mostly of willows. Most of the area within the channel is covered by annual grasses which had not been burned when surveyed on September 20, 1988.

The waterside and landside slopes of the levee along the west side of the channel generally have low value for wildlife. The levee slopes are mostly uplands, which had been partially burned when observed during a September 20, 1988 visit; only two small areas (one each) of emergent marsh and scrub-shrub exist.

Pleasant Grove Creek to Sankey Road. The channel within this reach includes cover-types such as upland, scrub-shrub, aquatic bed, open water, and emergent-marsh. One of the emergent marsh areas has relatively high plant species diversity. The open water areas are palustrine, with little moving water at any time.

The waterside and landside slopes of the levee along the west side of the channel are quite similar in cover and wildlife values to the levee slopes of the reach of the Main Drain discussed above.

Sankey Road to Interstate Highway 80. The cover-types present are upland, riparian forest, scrub-shrub, emergent marsh, open water and aquatic bed. Upland habitat, the predominant cover-type, is composed of mainly annual grasses such as wild oats and Bermuda grass. Proceeding downstream, the first occurrences of

riparian forest are roughly between Riego Road and Elkhorn Boulevard; however, most of the trees of this area are dead from unknown causes. A few small, moderate-value stands of living riparian forest exist just upstream from both Main Avenue and Highway 80. Scrub-shrub of the area consists mainly of one willow species and generally has low-to-moderate cover for wildlife. Some emergent marsh in this reach has high plant species diversity. The open water areas are primarily palustrine; only a few limited areas can be considered riverine open water.

The slopes of the westerly levee of this reach are covered mostly with annual grasses, most of which are burned. The toe drain has a small area of emergent marsh cover with a high diversity of plant species.

Interstate Highway 80 to Arcade Creek. Except for one occurrence of shaded riverine aquatic cover, the channel of this reach has the same cover types as the channel in the reach discussed above. The predominant cover-type remains uplands. However, there is slightly more riparian forest area than in the previous reach, and the riparian forest is of higher quality, and greater species diversity (cottonwood, willow, buttonbush and other species), with living trees. The majority of the open water area is riverine; the remainder is palustrine.

The landside and waterside slopes of the westerly levee of this reach are exclusively upland cover with relatively low overall habitat values. All of the levee slopes are burned.

Arcade Creek to American River. The channel in this reach has very high overall habitat value. The cover types include upland, riparian forest, shaded riverine aquatic, emergent marsh, and open water. In addition, part of the floodplain of the lower reach overlies the parklands of the American River Parkway near Discovery Park.

Most of the area is covered by riparian forest. This forest has excellent plant species diversity (all species present in riparian forest along the impacted reach of the Sacramento River, plus California buttonbush) and multilevel canopies. Also, both young and mature stands of forest are present. A unique stand of young oaks exists at the mouth of NEMDC. These various attributes combine to create riparian forest of very high value.

This reach has more shaded riverine aquatic cover than any previously discussed reach of either the Natomas Cross Canal or the NEMDC.

Emergent marsh is quite limited in area in the channel along this reach. Much of the emergent marsh is non-persistent growth of

smartweed along the edges of the riverine open water. The uplands are also limited in area and consist mostly of annual grasses which have not been burned.

The slopes of the westerly levee of this reach have habitat values ranging from low to moderate. Low-value, burned, upland grasses occur roughly from Arcade Creek downstream to El Camino Avenue, on both the landside and waterside levee slopes. From El Camino Avenue to Northgate Boulevard, the landside levee slope is vegetated with moderate-value riparian forest, while the waterside levee slope is mainly lower-value, burned, upland grasses. From Northgate Boulevard to the Garden Highway intersection, unburned upland grasses cover the waterside levee slope, while unburned upland grasses and scrub-shrub (oak, walnut, etc.) make up the landside levee slope. The levee slopes of the remaining area downstream to the mouth of the Main Drain include a combination of riparian forest and upland grasses on the waterside with primarily upland grasses on the landside. No evidence of burning was seen.

FISH

Although there are no in-channel modifications planned on the Sacramento River, there may be some impacts on anadromous fish which migrate up the Sacramento River and pass through canals (Natomas Cross Canal or NEMDC) into smaller tributary streams (Dry Creek, Auburn Ravine and Coon Creek). Thus, we have included description of Sacramento River fish resources. Fish resources of the lower American River are referenced in the lower American River substantiating report.

Sacramento River

The Sacramento River provides important habitat for a diverse assemblage of fishes, including both anadromous and resident species (Table 3). Anadromous fish include chinook salmon (four races, including the threatened winter-run), steelhead trout, striped bass, American shad, green and white sturgeon, and Pacific lamprey. Resident fish can be separated into warmwater

Table 3 Fishes of the Lower Sacramento River

Common Name	Scientific Name
	Anadromous Game Fish
Chinook salmon	Salmo gairdneri gairdneri
Steelhead	Oncorhynchus kisutch
Silver salmon	Oncorhynchus gorbuscha
Pink Salmon	Oncorhynchus keta
White sturgeon	Acipenser transmontanus
	Warmwater Game Fish
*Spotted bass	Micropterus punctualatus
*Largemouth bass	Micropterus salmoides
*Smallmouth bass	Micropterus dolomieui
*Warmouth bass	Lepomis gulosus
*Green sunfish	Lepomis cyanellus
*Bluegill	Lepomis machrochirus
*Redear sunfish	Lepomis microlophus
*White crappie	Pomoxis annularis
Sacramento perch	Archoplites interruptus
*Channel catfish	Ictalurus punctatus
*White catfish	Ictalurus catus
*Brown bullhead	Ictalurus nubulosus
*Black bullhead	Ictalurus melas
	Nongame Fish
Sacramento western sucker	Catostomus occidentalis
*Carp	Cyprinus carpio
*Goldfish	Carassius auratus
Sacramento blackfish	Orthodon microlepidotus
Hardhead	Mylopharodon conocephalus
Sacramento hitch	Lavinia exilicauda
Sacramento squawfish	Ptychocheilus grandis
Sacramento Splittail	Pogonichthys macrolepidotus[2]
*Mosquitofish	Gambusia affinis
Tule perch	Hysterocarpus traski
Riffle sculpin	Cottus gulosus
Pacific lamprey	Entosphenus tridentatus
*Threadfin shad	Dorosoma petenense
*Golden shiner	Notemigonus crysoleucas
*Fathead minnow	Pimephales promelas
Western roach	Hesperoleucas symmetricus
Sacramento tui chub	Gila bicolor
Speckled dace	Rhinichthys osculus sp.
*Log perch	Percina macrolepida

Source: Modified from Gerstung 1971.
Note: * Introduced species
[1] Possibly extirpated
[2] Federal candidate, Category 2.

gamefish such as largemouth bass, white crappie, black crappie, channel catfish, white catfish, brown bullhead, yellow bullhead, bluegill, and green sunfish; coldwater game fish such as rainbow and brown trout; and non-gamefish such as Sacramento squawfish, Sacramento sucker, and golden shiner. Native non-gamefish such as the Sacramento perch (California's only native sunfish) and the viviparous tule perch still persist in the Sacramento River. The Sacramento splittail, a candidate for Federal listing, may also occur in portions of the area, mainly in the mainstem Sacramento and lower American Rivers.

Chinook salmon are the most important fish to commercial and sport fishermen in California. Annual commercial catches are 2-14 million pounds and sport catches are 40,000-130,000 fish (Corps of Engineers 1985). The Sacramento River sustains the largest chinook salmon run in California; over 90 percent of the Central Valley salmon populations spawn in the Sacramento system, which contributes about one-half million chinook salmon annually to the commercial harvest of these fish in the Pacific Ocean (USFWS 1976).

Four runs of chinook salmon (fall, late fall, winter, and spring) occur in the Sacramento River. The fall-run chinook is the most abundant race, comprising about 80 percent of the Sacramento River basin stock (Kjelson et al. 1982). The winter-run race of the Sacramento River chinook salmon has been designated a threatened species under the Endangered Species Act. This race has suffered dramatic declines in abundance since 1969 (Hallock and Fisher 1985).

Other races of chinook salmon in the Sacramento River have declined substantially as well. The most extensive record of spawning stock estimates is for fall-run chinook salmon. The average counts above Red Bluff for 1950-59, 1960-69, 1970-79 are 190,000, 130,000, and 48,000 fish, respectively (Buer et al. 1984). The average count dropped to 33,000 fish for 1980-85. This is only 17 percent of the spawning population of the 1950s (Michny and Deibel 1986).

Steelhead trout comprise an important recreational fishery within the Sacramento River system. The runs ranged from about 14,000 to 28,000 adults annually during the period 1953-59 (Corps of Engineers 1985). Approximately 15 percent of the annual steelhead run in the Sacramento River is the result of hatchery-reared fish released as smolts and fingerlings.

Steelhead trout use the lower and middle Sacramento River as a migration corridor to and from spawning grounds on tributary streams. Spawning or rearing does not take place during summer and fall seasons in the vicinity of the project because water temperatures are unsuitable during those seasons. Steelhead are

present in the upper Sacramento River year-round. Most spawning fish move upstream in the fall and winter. Juvenile emigration occurs primarily during the spring after 2 or more years of rearing in upstream areas.

Approximately two-thirds of the striped bass in Central Valley streams spawn in the Sacramento River system (DFG 1966). The striped bass population of the Sacramento River system has been estimated at between 1.5 and 4 million adult fish, with approximately 55-66 percent of the population spawning in the Sacramento River (DFG 1972). An annual catch of 250,000 fish results from 1.5 million angler-days. Juvenile and adult striped bass abundance has declined over the last 15-20 years, and intensive studies are being conducted to determine the causes.

Adult striped bass are found in the Sacramento River only during spawning runs from April to June. Most spawning is confined between Isleton and Butte City. Semibuoyant eggs and larvae are carried downstream near the bottom and mid-channel into the Delta and Suisun Bay. Most eggs hatch between Courtland and Sacramento. Larger larvae and juveniles tend to concentrate near the shoreline. During their second year, young bass may move back upstream from the Delta into the Sacramento River.

Virtually the entire American shad population spawns in the Sacramento River system (1966). The American shad population has grown tremendously in the last few years, and the adult population is now estimated to be several million (USFWS 1976). With the decline of striped bass and other species, the shad fishery has become increasingly popular.

American shad are similar to striped bass in their use of the Sacramento River. Adult fish are present only from April to June during spawning migrations. Spawning occurs in the Sacramento River above Hood and in tributaries. Semibuoyant eggs gradually drift downstream before hatching. Some newly hatched shad begin downstream migration immediately, while others remain near spawning areas until they reach about 75 mm in length. Juvenile shad are common in the river from July through November during a protracted outmigration period. Larvae and young juveniles occur in greatest abundance in the Sacramento River from Freeport downstream. Juvenile shad appear to favor the inside of river bends or sandy bars.

The adult population of white sturgeon is estimated to be 72,000-212,000 fish (Miller 1972), with an average annual catch of approximately 8,500 fish (Moyle 1976). Green sturgeon population levels are unknown, but are believed to be smaller than that of the white sturgeon.

Adult sturgeon are found in the Sacramento River from March to June during spawning migrations. White sturgeon are believed to migrate farther upstream than green sturgeon. The adhesive eggs stick to the substrate after fertilization. Larvae stay close to the bottom after hatching and are washed downstream into the estuary.

Remnant, and thus highly significant, populations of the Sacramento perch occur in the Sacramento system. Although the species is thought to be threatened with extinction in the Sacramento River, it is presently listed as a category 2 candidate by the Service and "status-undetermined" by the California Department of Fish and Game, pending collection of additional information (DF&G, 1972).

South and North Natomas Areas

The South Natomas area is partially bounded by the Sacramento and American Rivers. Significant open waters in the area include the NEMDC, Natomas Main Drain, and First Bannon Slough. There are also many smaller agricultural supply and drainage canals which provide some habitat for various species of fish. Habitat quality in the drainage canals and sloughs in South Natomas is generally of much lower quality than in the major rivers due to undependable flows, contaminants, warm temperatures, disturbance, and lack of management. In spite of this, most of the species listed in Table 3 for the lower Sacramento River are found in these drains and canals.

North Natomas is bounded on the west by the Sacramento River, on the north by the Sacramento County line (north of Elverta Road), and on the east by the NEMDC. Fish resources are as described for South Natomas.

The NEMDC collects waters of several natural creeks including Dry and Arcade Creeks and other rural and urban runoff sources. It begins in Sutter County just south of Sankey Road and flows through Sacramento County for about 15 miles before entering the Sacramento River just north of the confluence of the American River. In the fall, adult chinook salmon use the Natomas East Main Drain as a migration route to reach spawning grounds in Dry Creek, and Minor and Secret Ravines. Juvenile salmon emigrate downstream from these same areas through the canal into the Sacramento River in the spring. The California Department of Fish and Game has been stocking young salmon in Dry Creek and several tributaries for a number of years in an effort to establish a consistent salmon run. Warmwater fish including bass, bluegill, catfish, bullhead, sunfish and other non-game species are common year-round residents in the NEMDC.

Another important water body within the North Natomas area is Fisherman's Lake, a 2.1-mile-long widened segment of the West Drain. The shallow, warmwater lake is surrounded by a dense canopy of mature willows and cottonwoods. This mixed riparian forest provides shade and a food source (terrestrial invertebrates) for the fish populations inhabiting Fisherman's Lake.

The lake supports numerous warmwater gamefish, primarily members of the catfish and sunfish families. Largemouth bass, bluegill, green sunfish, and bullhead and other catfish species support a limited recreational fishery for local residents. The lake typically is fished by three or four people daily, but on occasion as many as 15 individuals have been observed fishing at the site. Most of the captured fish are kept for consumption (Prosser pers. comm.)

The East and West Drains and the NEMDC are hydraulically connected to Fisherman's Lake, and probably contain similar species. Habitat quality is much lower in the drains and canals than in Fisherman's Lake; therefore, fish abundance is probably less.

The Natomas Cross Canal is the largest open water body other than the Sacramento River in South Sutter County. Several Sierra foothill streams including Markham Ravine, Coon Creek and Auburn Ravine to name a few flow into the Cross Canal via the East Side Canal. In the fall, chinook salmon migrate upstream through the Cross Canal to these streams and spawn in headwaters. In the spring, salmon juveniles emigrate from the headwaters downstream through the Cross Canal into the Sacramento River on their way to sea. Occasional steelhead also pass through the Cross Canal and continue upstream to spawn but there is no consistent run. Similar warmwater gamefish such as catfish, bullhead, sunfish, and bass along with non-game species are present year-round in the Cross Canal. There is a significant amount of sport fishing activity year-round in the Cross Canal. Public access is possible by boat from the Sacramento River, or by foot from the levee at the Garden Highway or State Highway 70/99 crossing. Fishing activity is concentrated near the highway access point. Two other main open water bodies in South Sutter County are the North and East Drainage Canals which convey drainage water to the Pritchard Lake Pumping Station. From the pumping station water can be discharged through the East Drain into Fisherman's Lake and then into the Natomas Main Drain, or to a pump station from where it is pumped into the Sacramento River. Similar warmwater species as in the Natomas Cross Canal are present in lesser abundance in these drains and canals.

Fish resources in lower 1.3 miles of Dry Creek include anadromous coldwater gamefish, warmwater gamefish, and non-game species. As previously described for the NEMDC, in the fall and winter, adult chinook salmon and a few steelhead migrate into Dry Creek and its tributaries to spawn. In order to maintain a consistent salmon run, the California Department of Fish and Game plants young salmon smolts each year in Dry Creek. During the remainder of the year, flows gradually decrease but levels generally remain sufficient to support reduced populations of warmwater gamefish and non-gamefish. Consistent sport fishing activity occurs near the confluence of Dry Creek and the NEMDC and at other locations where public access is available.

Fish resources in the lower 2.9 miles of Arcade Creek are much less than in the previously described project impact areas. Development, urban runoff, reduced flows, high water temperatures, concrete levee construction and other factors have drastically reduced fish habitat values. In spite of these factors, there are small populations of warmwater gamefish and non-game species. Sunfish, bullhead, carp and mosquitofish, to name a few, are present in the creek. Although fish populations are greatly reduced, local residents take part in sport fishing activity along the levee berms and near road crossings where public access is available.

WILDLIFE

The Natomas Area supports a highly significant and diverse Sacramento Valley wildlife assemblage. Typical vertebrate wildlife occurring in Natomas are listed in Table 4. The high wildlife values of the Natomas Area are the consequence of several factors. First, the area lies at a critical geographical location, at the junction of two major rivers and the terminus of many natural drainages. The artificial drainages associated with agriculture in the area also provide important wildlife habitat, mostly because of the absence of suitable habitats in the adjoining urban areas of the region, and only seasonally available habitats in the cultivated fields. These existing water features, that occur essentially throughout the area, provide not only high value wildlife habitats, but also critical migratory links and connecting corridors for virtually all terrestrial wildlife species as well as many resident and migratory birds. Second, because of the unique topographical and soil structural characteristics, the area still exists to a great extent as one of the largest floodplains and flood basins in the southern Sacramento Valley. Third, despite the extensive, agriculturally altered conditions of the area, the Natomas interior and the adjoining Yolo and Sacramento Bypasses still offer a multitude of valuable habitats for wildlife of the Sacramento region, including enormous expanses of annually

Table 4

REPRESENTATIVE VERTEBRATE WILDLIFE OF THE NATOMAS AREA BY COVER TYPE

OPEN WATER (including flooded rice fields).

__MMALS__

..skrat
Beaver
R..er otter
(on large streams)

__RDS__

..ed-billed grebe
Bald eagle*
Double-crested
cormorant
Canada goose
Mallard
Pintail
American coot
Ruddy duck
Wood duck
Forster's tern
California gull
Whistling swan
Snow goose
Ross' goose
Cinnamon teal
American widgeon
Kingfisher
Black tern
Common goldeneye
Lesser scaup

__REPTILES/AMPHIBIANS__

Giant garter snake*
Common garter snake
Tiger salamander*
Bull frog
Red legged frog**
Western pond turtle

..ESHWATER MARSH & MARGINS OF OPEN WATER

__MAMMALS__

Muskrat
Beaver
..iver otter
..rvest mouse
..hrews
Long-tailed weasel
Skunk
Various bats
(forage in the air
over marshes)

__BIRDS__

Great blue heron
Western
yellowthroat
..reen heron
Marsh wren
Black-crowned night
heron
Killdeer
Belted kingfisher
Black phoebe
Black tern
Yellow-headed
blackbird
Tricolored
blackbird
Red-winged
blackbird
Bewick wren
Song sparrow
Bittern
Purple gallinule
Great egret
Snowy egret
Cattle egret
Yellow rail
Sora
Long-billed curlew
Yellowlegs
Willet
Black-necked stilt
Northern harrier

__REPTILES/AMPHIBIANS__

Giant garter snake*
Common garter snake
Tiger salamander*
Bull frog
Pacific tree frog
Western toad
Gopher snake

..IPARIAN SCRUB-SHRUB

__..MMALS__

Opossum
Shrews
Beaver
..ong-tailed weasel
..kunk
..ocket gopher
..arvest mouse
Cottontail
California vole
Deer mouse
..lack-tailed deer
..ats
..iver otter
Ring-tailed cat
Raccoon

__BIRDS__

Great blue heron
Egret
Green heron
Wood duck
Black-shouldered
kite
Yellow-billed
cuckoo*
Screech owl
Tree swallow
Black phoebe
Bewick wren
Yellow-throat
Brown towhee
Rufous-sided towhee
Scrub jay
Downy woodpecker
Barn owl
White-crowned
sparrow

__REPTILES/AMPHIBIANS__

Common garter snake
Bull frog
Red-legged frog**
Pacific tree frog
Gopher snake
Common king snake
Alligator lizard
Racer
Tiger salamander

..ALLEY RIPARIAN FOREST

__MAMMALS__

Opossum
Shrews (several
species)
Mole
Coyote
Gray fox
Gray squirrel
Pocket gopher
Wood rat
California ground
squirrel
Cottontail
Black-tailed deer
Beaver
Long-tailed weasel
Harvest mouse
Deer mouse
Ring-tailed cat
Swainon's hawk*
Red-shouldered hawk
Yellow-billed
cuckoo**
Great horned owl
Screech owl
Anna's hummingbird
flicker
Scrub jay
Tree swallow
House wren
Violet-green
swallow

__BIRDS__

Great blue heron
Wood duck
Turkey vulture
Black shouldered
kite
American kestrel
Red-tailed hawk
Bewick wren
Vireo's (several
species)
Warblers (several
species)
Black-headed
grosbeak
Rufous-sided and
Brown towhee
Finches (several
species)
Fox sparrow
Titmouse
Western tanager
Western blue bird
Golden-crowned
sparrow
Crow
Woodpecker (several
species)
Robin
Northern oriole

__REPTILES/AMPHIBIANS__

Common garter snake
Alligator lizard
Western fence
lizard
Slender salamander
Racer
Gopher snake
Ring-necked snake
Pacific tree frog

VALLEY OAK WOODLAND

__MAMMALS__

Opossum
Shrew (several
species)
Mole
Raccoon
Long-tailed weasel
Skunk
Gray fox
Coyote
Gray squirrel
Calif. ground
squirrel
Pocket gopher
Deer mouse
Black-tailed deer

__BIRDS__

American Kestrel
Turkey vulture
Black-shouldered
kite
Rough-legged hawk
Swainson's hawk
Mourning dove
Great horned owl
Barn owl
Screech owl
Anna's hummingbird
Woodpecker (several
species)
Ash throated
flycatcher
King bird
Scrub jay
Finches (several
species)
Warblers (several
species)
Western blue bird
Western tanager
Crow
Raven
Woodpecker (several
species)
Robin
Meadowlark
Northern oriole
Sharp-shinned hawk
Yellow-billed
magpie
Lark sparrow
White-crowned
sparrow

__REPTILES/AMPHIBIANS__

Western fence
lizard
Skinks
Alligator lizard
King snake
Gopher snake
Rattle snake
Western toad
Pacific tree frog
Slender salamander
Ring-necked snake
Racer
Common garter snake
Tiger salamander*

GRASSLAND/SAVANNA

__MAMMALS__

Opossum
Mole
Skunk
Gray fox
Coyote
Bats (several
species)
Calif. ground
squirrel
Pocket gopher
Harvest mouse
Deer mouse
California vole
Black-tailed hare
Black-tailed deer

__BIRDS__

Turkey vulture
American Kestrel
Black-shouldered
kite
Red-tailed hawk
Swainson's hawk
Golden eagle
Mourning dove
Acorn woodpecker
Western blue bird
Loggerhead shrike
Yellow-billed
magpie
Crow
Raven
Kingbird
Northern oriole
Finches (several
species)
Horned lark
Lark sparrow
White-crowned
sparrow
Brewer's blackbird
Golden-crowned
sparrow
Great horned owl
Barn owl

__REPTILES/AMPHIBIANS__

Horned lizard
Western fence
lizard
Common king snake
Gopher snake
Racer
Western toad
Alligator lizard
Common garter snake
Tiger salamander*

GRASSLAND, LEVEE SIDES AND OLDFIELD

__MAMMALS__

Opossum
Mole
Skunk
Gray fox
Coyote
Bats (several
species)
Calif. ground
squirrel
Pocket gopher
Harvest mouse
Deer mouse
California vole
Black-tailed hare
Black-tailed deer

__BIRDS__

Turkey vulure
American kestrel
Black-shouldered
kite
Red-tailed hawk
Swainson's hawk
Golden eagle
Mourning dove
Acorn woodpecker
Western blue bird
Loggerhead shrike
Yellow-billed
magpie
Crow
Raven
Kingbird
Northern oriole
Finches (several
species)
Horned lark
Lark sparrow
White-crowned
sparrow
Brewer's blackbird
Golden-crowned
sparrow
Great horned owl
Barn owl
Northern harrier

__REPTILES/AMPHIBIANS__

Horned lizard
Western fence
lizard
Common king snake
Gopher snake
Racer
Western toad
Alligator lizard
Common garter snake
Tiger salamander*

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* SPECIAL STATUS SPECIES

[1] UNCONFIRMED WITHIN THE AREA, BUT WITHIN THE SPECIES RANGE

[2] COMPLETE LIST OF VERTEBRATES IS PROVIDED IN APPENDIX

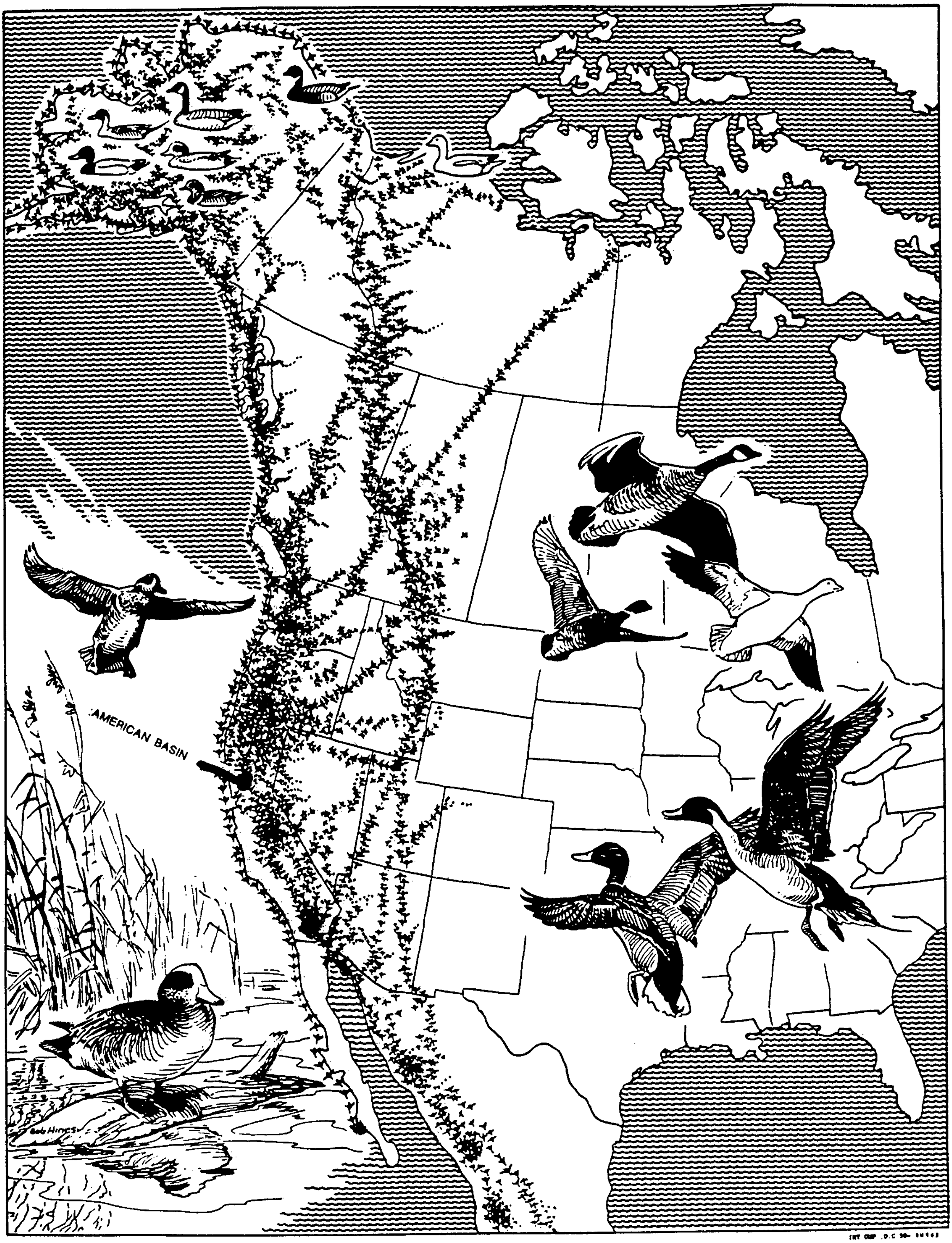
flooded ricelands, grain fields, orchards and row crops. These land uses, while certainly not as desirable for wildlife as natural wildlands, do constitute some of the most productive wildlife habitats of any altered land use type. Moreover, one of the most critical considerations is that agricultural land retains high potential for restoration while urban uses generally preclude opportunities for restoration. And finally, the area constitutes the most extensive expanse of essentially unurbanized land in the Sacramento metropolitan region, comprised mostly of enormous expanses of ricelands, associated drainageways, sloughs, and pockets of remnant wildland habitats. With these important features, Natomas includes one of the last and largest expanses of unurbanized, natural overflow lands and highly significant, essentially irreplaceable wildlife ecosystems in the southern Sacramento Valley region.

Located along a major flyway (Pacific Flyway) the American River Basin and Natomas Area within it are important components of an essential corridor for migratory bird movement (Figures 16 and 17). Thousands of migratory waterfowl rely on the habitat in the basin each year for resting, foraging and breeding purposes. (Dr. Mickey Heitmeyer, Calif. Waterfowl Assoc., pers. comm. 1989, USFWS 1989c). Photos of ducks, geese and swans taken by FWS personnel in December 1989 are shown in Figures 18 and 19. California Department of Fish and Game mid-winter surveys for ducks, geese and swans for the Natomas, Verona, Yolo and Sutter Bypass areas for the last 10 years provide some indication of the high use in the area (Figures 20 and 21). Further evidence of high use comes from the Sacramento Audubon Society Christmas Bird counts, annual 1 day events which include counts for ducks, swans, geese, wading and diving birds. Records of counts from 1976 to 1989 are shown in Figures 22, 23 and 24.

Service biologists have noted that thousands of pintail ducks roost by day in the Yolo Bypass and forage at night in the rice and grain fields of Natomas. The Natomas area is known to be the major mallard nesting area of the Sacramento Valley (Michael Miller, Pers. Comm.). As part of the Sacramento County Breeding Bird Atlas Project, Audubon staff have gathered data that indicate at least four of five species studied, including snowy egret, black-crowned night heron, mallard and cinnamon teal (data for American bittern is fragmented), reach their highest reported breeding densities in the northwestern corner of Sacramento County in the rice fields and wetland habitats (Sacramento Audubon, 1990).

Near the confluence of the American and Sacramento Rivers the most commonly observed wildlife include those species typically associated with the highly diverse and productive riverine riparian and remnant upland habitats present along the two

FIGURE 16 PACIFIC FLYWAY



UNITED STATES DEPARTMENT OF THE INTERIOR • FISH AND WILDLIFE SERVICE

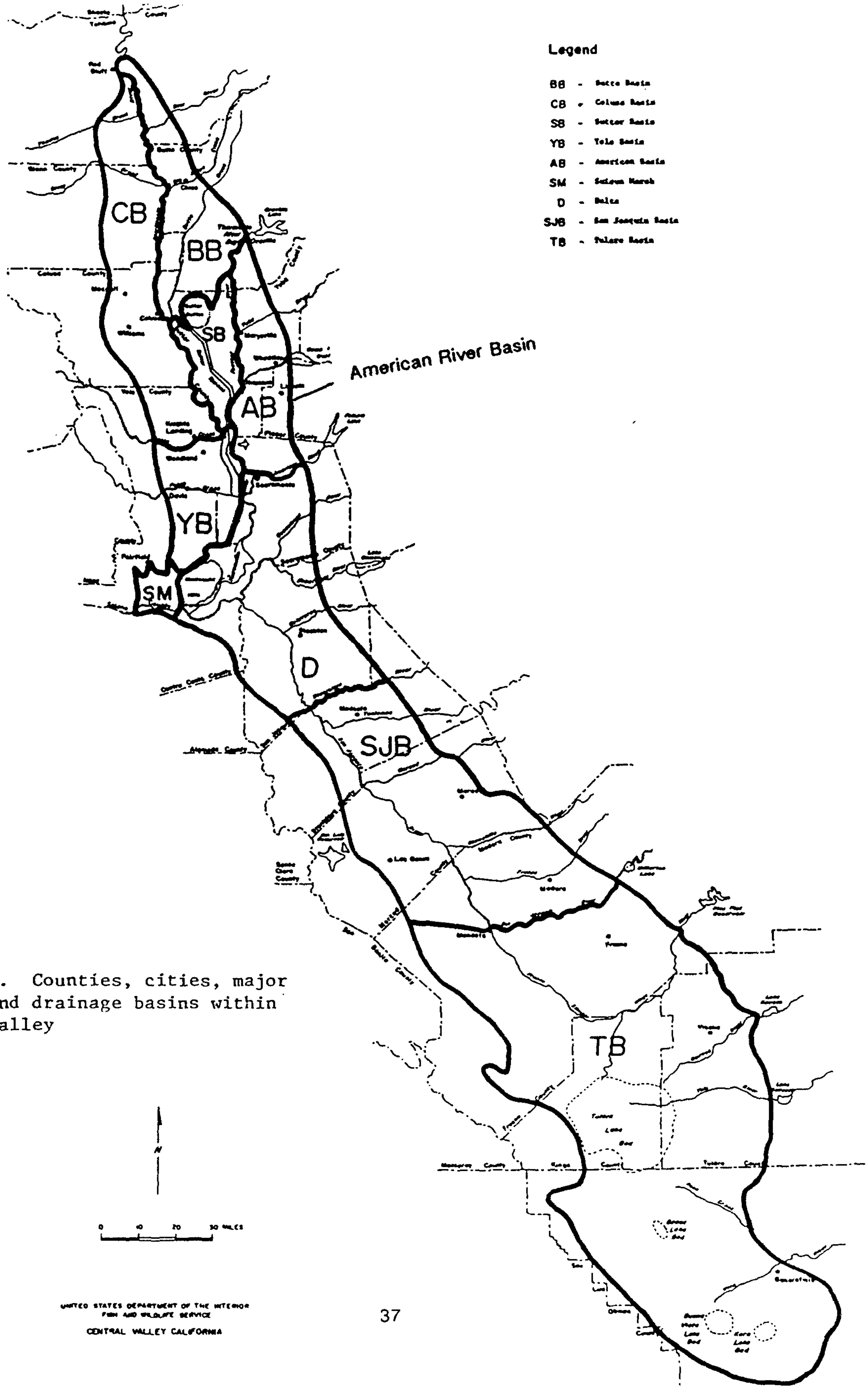


Figure 17. Counties, cities, major rivers, and drainage basins within Central Valley

Figure 18 Wintering Waterfowl in Natomas Area.

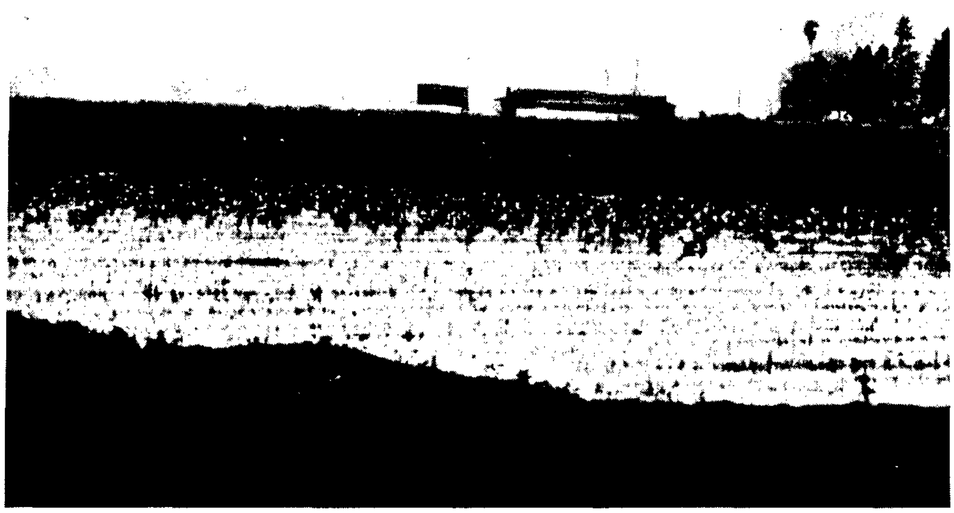


Figure 19 Wintering Waterfowl in Natomas Area.

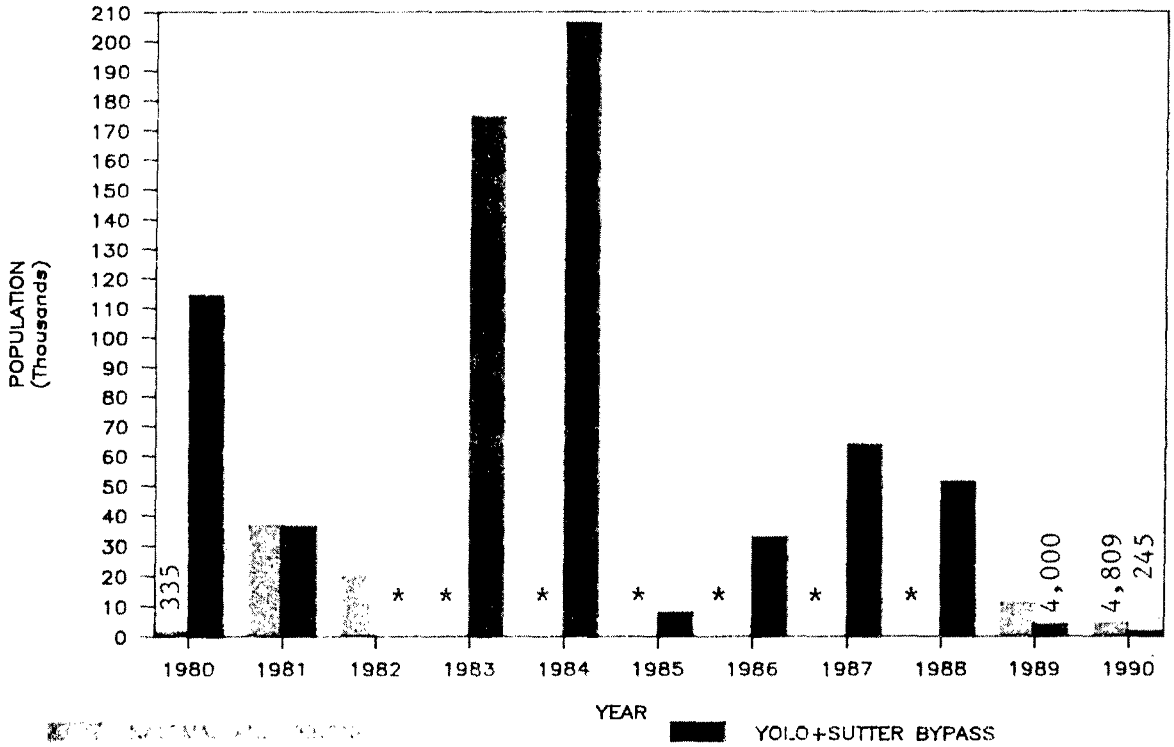


Figure 20. California Department of Fish and Game mid-winter waterfowl surveys, 1980-1990 (ducks). (See detailed counts in Appendix E).

*No survey made.

Source: California Department of Fish and Game, 1990.

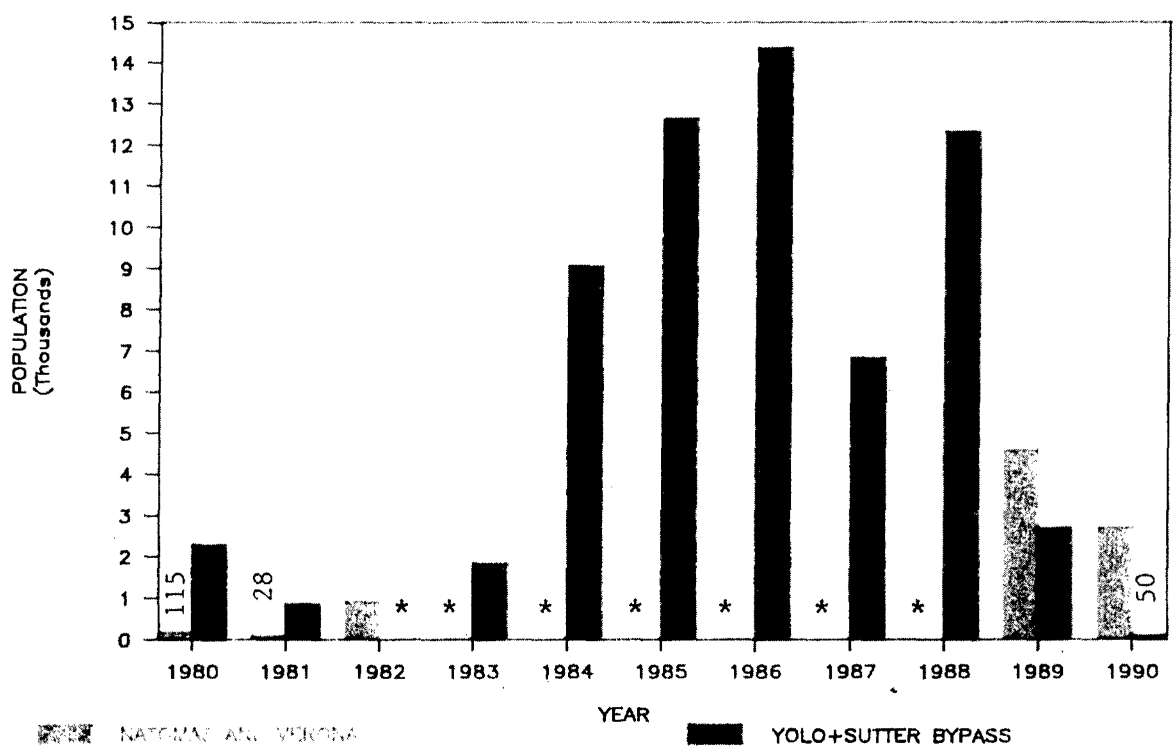


Figure 21. California Department of Fish and Game mid-winter waterfowl surveys, 1980-1990 (swans and geese). (See detailed counts in Appendix E).

*No survey made.

Source: California Department of Fish and Game, 1990.

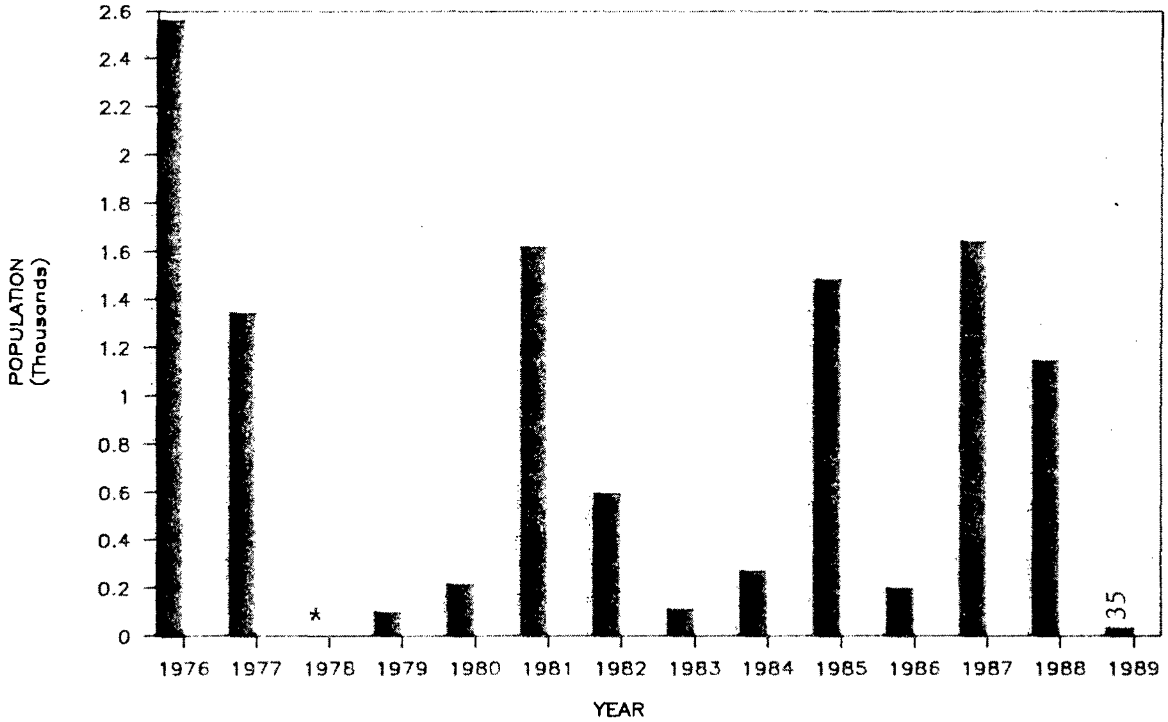


Figure 22 . Sacramento Audubon Society Christmas bird count survey for Sacramento County, 1976-1989 (swans and geese). (See detailed counts in Appendix F).

*No survey made.
Source: Sacramento Audubon Society, 1990.

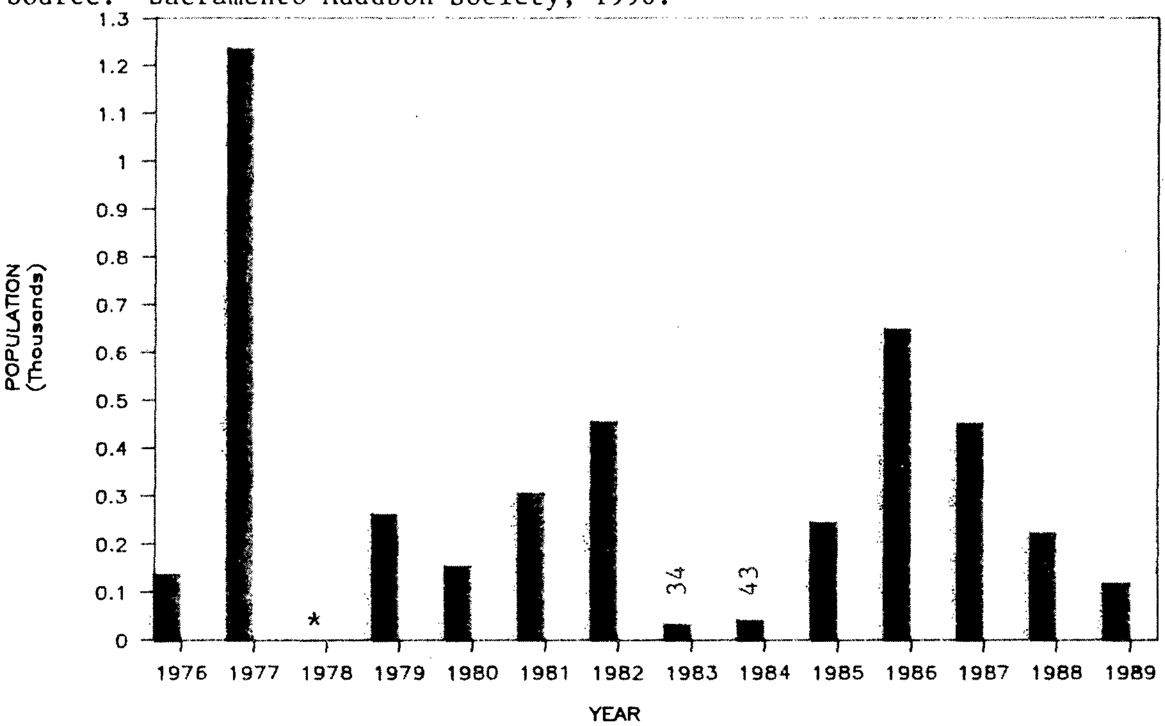


Figure 23 . Sacramento Audubon Society Christmas bird count survey for Sacramento County, 1976-1989 (ducks). (See detailed counts in Appendix F).

*No survey made.
Source: Sacramento Audubon Society, 1990.

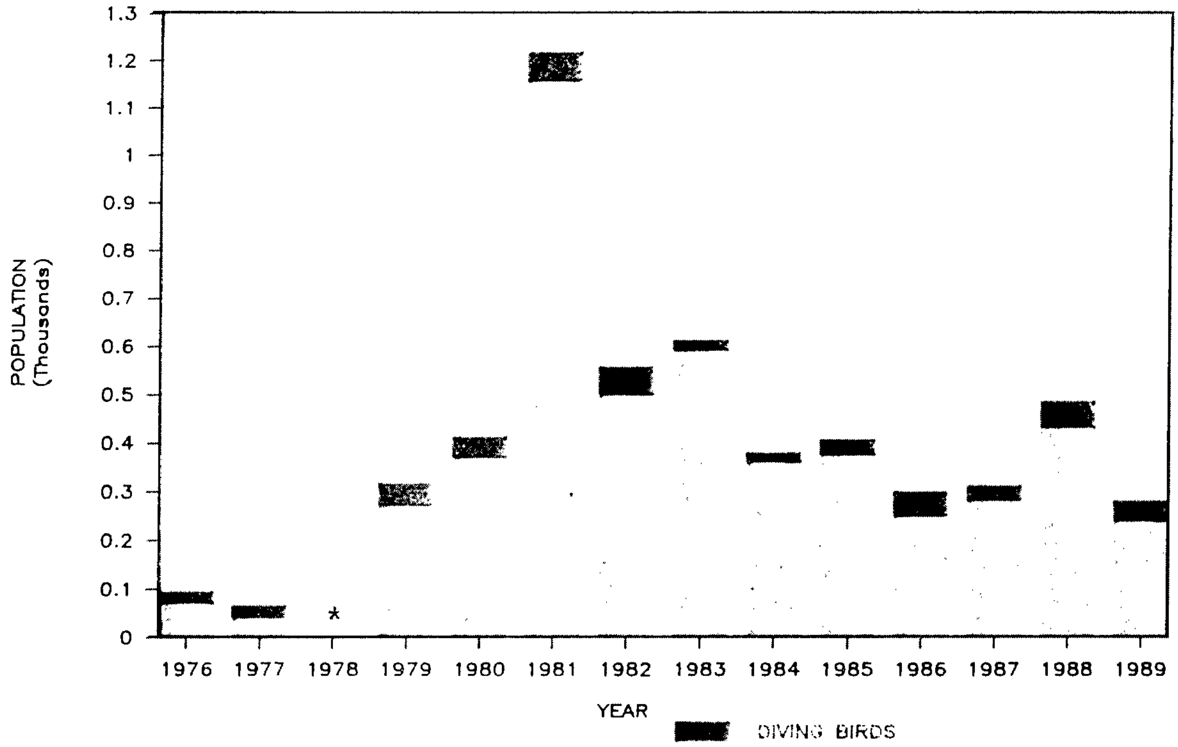


Figure 24. Sacramento Audubon Society Christmas bird count survey for Sacramento County, 1976-1989 (wading birds and diving birds). (See detailed counts in Appendix F).

*No survey made.

Source: Sacramento Audubon Society, 1990.

bordering river corridors. The greatest wildlife values occur on the waterside of the levees where the most extensive riverine riparian habitats remain. However, many of these same wildlife species also occur on the landside wherever remnant stands of riparian or relatively undisturbed vegetation have been retained. Such sites usually exist as small, isolated pockets or neglected banks often of a few acres or less.

<u>Sacramento River--American River Mouth to Natomas Cross Canal Mouth</u>

<u>Uplands</u>. Grassland cover (grasses and forbs interspersed with scrub-shrub vegetation), which dominates much of the landside levee berms and crowns on both sides of the Sacramento River in this reach, has low to moderate wildlife habitat value due to levee maintenance practices (mowing and burning). The short-eared owl and songbirds including meadowlark, starling, mockingbird and scrub jay are common. California voles, field mice, jack rabbit, and other rodents and mammals are also common (Table 4). These species nest and forage in the grassland. Several raptors including American kestrel, red-tailed hawk, and black-shouldered kite prey on small reptiles and rodents in the grassland.

Orchards on the west side of the Sacramento River levee provide relatively low wildlife values due to the spraying and discing of ground cover and hazing practices. However, several species of birds including blackbirds, starlings, magpie, scrub-jay and crow nest and forage in the orchards. Grain and row crops on the west side of the Sacramento River provide important seasonal habitat for wildlife. They support high rodent populations which in turn support a variety of raptors such as the State-listed Swainson's hawk, and the red-tailed hawk, black shoulder kite, kestrel and others. Grains remaining after harvest are an important food source for ring-necked pheasant and wintering waterfowl. Grain fields also provide important habitat for owls such as the short-eared owl.

To the east of the Sacramento River levee, in the extensive Natomas interior, wildlife typically include those species most commonly associated with agricultural fields of rice, dryland grains and pasture. The interspersion of several other lesser crop types (e.g., orchards, vineyards, row crops) and localized small urban/residential developments contribute to the species diversity, although they generally effect a less desirable, largely negative influence on the indigenous wildlife of the area.

Throughout the Natomas area, especially within the large expanses of grain crops of the interior, distinct and significant seasonal

trends in bird species abundance and composition occur. For example, many wetland associated birds use periodically flooded (irrigated) rice fields (Miller et al. 1989, Lee 1984; Mickey Heitmeyer, California Waterfowl Association, pers. comm. 1989). When flooded, large numbers of herons, egrets, ducks, geese, swans, and other waterbirds, congregate along the rice checks, drainage canals, sloughs, and in the rice fields. Even during nonflooded periods, many birds and mammals (both wetland and upland species) can be found using areas where dense vegetation has been retained, such as along rice checks, sloughs and drainage canals.

Many upland game species (birds and mammals) use corn and other dry grain fields, especially after harvest when old stalks and grain residues are left on the untilled soil. Orchards frequently support many of the more common woodland birds including scrub jay, magpie, mocking bird, flycatchers, and other passerine species.

The natural and uncultivated vegetation types of the Natomas area, described earlier, all support diverse and significant wildlife populations. Native or relatively natural areas are particularly important for wildlife because of their more stable nature (i.e., year-round availability of food, cover and water) as compared to areas seasonally or more frequently cleared and disked for agriculture.

Ruderal Uplands and Fallow Oldfields. Fallow fields and other mixed forb-grassland stands and ruderal uplands and levee slopes, depending on their size, rotation periods, disturbance periodicity, and adjacent cover types, support a wide range of interesting and important wildlife species. Those species most commonly found in these habitats include pocket gopher, brush rabbit, voles and other small mammals, coyote, fox, skunk, various grassland-associated sparrows, horned lark, mourning dove, blackbirds, American and lesser goldfinch, pheasant, gopher snake, common garter snake, king snake, and a multitude of invertebrates (Table 4).

Although agriculture undoubtedly caused the greatest alteration to the natural habitats and wildlife of the Natomas Area, the remaining habitat, as it now exists, is essential for survival of the plant and animal species now found there (Table 4).

Open Water Habitats. Open water habitats, many of which are associated with rice fields and drainage canals, support a great variety of water-associated wildlife species including muskrat, beaver, and migratory and resident waterfowl and waterbirds (Table 4). The bird species most commonly encountered include American coot, purple gallinule, mallard, pintail, kingfisher,

great blue heron, Forster's tern, pied-billed grebe, and American wideon. Many species of waterbirds use the open water networks on a seasonal basis during fall and winter migration. Historically, the area consisted of thousands of acres of natural marsh and open water habitats that supported huge waterfowl and waterbird concentrations numbering in the hundreds of thousands. These species still congregate in the area (Figure 18 and 19), but now, because of the severely reduced extent and agriculturally altered condition of the remaining habitat, numbers are greatly diminished, though still impressive and significant (Mickey Heitmeyer, pers. comm. 1989, USFWS 1989a, b).

Palustrine Emergent Marsh. Because of the large acreages of rice and the numerous associated drainage canals and sloughs, marsh- and open water-associated species occur throughout the Natomas Area. The expansive networks of rice checks, canals and sloughs, which typically support tall stands of bullrush, cattails and other dense emergent marsh plants, provide excellent cover for numerous species that inhabit natural freshwater marsh areas such as Fisherman's Lake and associated First Bannon Slough. This area not only provides riparian cover and feeding areas for a wide variety of riparian, marsh and open water wildlife species (Table 4), it is one of the largest roosting and nesting areas in the Natomas Area for egrets, herons and bitterns.

Palustrine Forest and Palustrine Scrub-Shrub. Mixed riparian forest and scrub-shrub with its high productivity and diversity of tree, shrub and forbs provide abundant fruits, seeds, and nectar resources for species such as hummingbirds, scrub jay, black-headed grosbeak, rufous-sided towhee, Virginia opossum, raccoon, gray fox, and western gray squirrel (Table 4). This cover also supports many insect-eating species such as fox sparrow, flycatchers, warblers, vireos, white-breasted nuthatch, shrews, moles, badger, and ringtail.

The high availability of mast, fleshy forbs and grasses and dense cover in riparian forest provides excellent habitat for game species such as deer, turkey, pheasant, and quail.

Many less obvious species of reptiles and amphibians use and depend upon the dense cover afforded by the valley riparian forests, including western toad, Pacific tree frog, western pond turtle, western fence lizard, southern alligator lizard, western skunk, common garter snake, and gopher snake.

This typically dense-growth woody habitat type provides excellent cover for both upland and lowland wildlife species (Table 4). Dense scrub-shrub willow thickets occur along many of the permanent drains and waterways in narrow bands. The thickets are frequently used as rookery and roosting sites by herons, egrets,

and black-shouldered kite. Roosting/rookery sites occur north of the Sacramento Metropolitan Airport along a small canal, in lower Arcade Creek, in the Natomas Cross Canal, and NEMDC.

Songbirds such as western flycatcher, black phoebe, various sparrows and warblers feed on insects that are abundant in the willows and other woody plants of this habitat. Beaver and muskrat occur in this habitat when it lies close to permanent water and affords soft dirt banks and levees for burrows. Beaver also feed on young willow and alder.

<u>Natomas Cross Canal--Sacramento River to Confluence to NEMDC</u>

Wildlife values along and within the Natomas Cross Canal are high. This area is a highly significant post-hunting-season feeding area for migratory waterfowl. Thousands of geese, ducks, swans and other waterbirds move into these areas to feed on rice and other grains and herbage during the flooded periods. A radio tracking study of pintails (Michael Miller USFWS 1989-90, unpub.) found that 100 percent of radio-collared birds used this area during the post-hunting season to feed. Highly significant bird use occurs as far south as the Sacramento Metropolitan Airport in most years.

The high value for wildlife (Table 4) of the channel area between the levees is due to (1) the variety of cover-types, (2) the diversity of plant species within the cover-types, and (3) the relative lack of human activity and disturbances along the Cross Canal (road access along the levee is controlled through locked levee-district gates; access by boat is frequently limited due to low water). During a survey on September 22, 1988, a wide range of waterbirds and other birds were seen, including herons (great blue; black-crowned night), egrets (great; snowy), ducks, coots, kingfishers, raptors (six species, including merlin), black phoebe, scrub jay, common crow, pheasant, and goldfinches (various species). The channel area is very valuable for raptors, herons, egrets, and waterfowl.

The upland interspersed with small pockets of riparian scrub-shrub along the waterside slopes of the south levee of the Cross Canal is only low-to-moderate in value for wildlife. Habitat values are low primarily because of the annual burning of vegetation by the managing levee district. Species inhabiting these cover types are similar to those described in previous sections.

The wildlife species (Table 4) found on the landside levee slopes of the south levee of the Cross Canal are very similar to those found on the waterside levee slopes. This is due primarily to the similarity of cover and habitat types and the annual burning

which keeps habitat values relatively low. Also, the emergent marsh in and along the toe drains at the landside slope of the south levee provides habitat for a wide array of birds and small mammals (previously described). It provides important feeding, nesting, or cover habitats for these species. Ring-necked pheasants use these areas extensively for cover, and high numbers occur throughout the adjoining rice fields, along the checks, and within the water control canals.

Natomas East Main Drainage Canal

Because of the similarity of habitat types of this reach to the Natomas Cross Canal, except for palustrine open water, wildlife species found in these areas are also similar (Table 4). However, the quality of the habitat is degraded in comparison to that of the Natomas Cross Canal, thereby resulting in smaller populations of individual species.

Howsley Road to Pleasant Grove Creek. Wildlife species inhabiting the channel are similar to those found in the same habitat types previously identified (Table 4). Open water, scrub-shrub, emergent marsh, and upland cover types are present, but only the emergent marsh provides any significant value for wildlife. The area within the channel is vegetated primarily by annual grasses with a few areas of scrub-shrub, and a small area of riparian forest.

The waterside and landside slopes of the levee along the west side of the channel are of low value for wildlife. Wildlife species inhabiting the levee slopes are similar to levee slopes throughout the Natomas Area (Table 4). Because the levee slopes consist primarily of annual grasses and are partially burned periodically, they are of low value for these species.

Pleasant Grove Creek to Sankey Road. Wildlife species inhabiting uplands, scrub-shrub, aquatic bed, open water, and emergent marsh of the channel in this reach (Table 4) are similar to those found throughout the Natomas Area in similar habitat types. Of the habitat types found in the area, the emergent marsh provides the highest wildlife habitat values.

The waterside and landside slopes of the levee along the west side of the channel are similar in wildlife species, cover and wildlife values to the levee slopes of the reach of the Main Drain discussed above.

Sankey Road to Interstate Highway 80. The channel of this reach varies from low to moderate in overall habitat values for wildlife. Wildlife species inhabiting the uplands, riparian forest, scrub-shrub, emergent marsh, open water and aquatic bed

of the channel (Table 4) are similar to those found throughout the Natomas Area. Of the habitat types occurring in the area, only the emergent marsh has a high diversity of plant species which provides excellent habitat values for wildlife.

The slopes of the westerly levee of this reach support annual grasses (uplands), most of which are burned. Values for wildlife (Table 4) are thus uniformly low, except along the toe drain which exists at the base of the landside levee slope in the vicinity of Riego Road. This toe drain has a small area of emergent marsh cover with associated high values for wildlife, due to high diversity of plant species.

Interstate Highway 80 to Arcade Creek. Except for one occurrence of shaded riverine aquatic cover, the channel of this reach has the same cover types and hence the same wildlife species (Table 4) as the channel in the previous reach. However, because there is slightly more riparian forest area than in the previous reach, and the riparian forest is of higher quality and better species diversity (cottonwood, willow, buttonbush and other species), the value of the habitat is greater for wildlife.

The landside and waterside slopes of the westerly levee of this reach are exclusively uplands with relatively low overall habitat values for wildlife species inhabiting the area (Table 4). All of the levee slopes are burned.

Arcade Creek to American River. The channel in this reach has very high overall habitat values. Wildlife inhabiting the uplands, riparian forest, shaded riverine aquatic, emergent marsh, and open water of the channel are similar to those found in the Natomas Area.

The high value of the channel to wildlife is based on (1) excellent plant species diversity (all species present in riparian forest along the impacted reach of the Sacramento River, plus California buttonbush) and multilevel canopies, (2) young and mature stands of forest, and (3) a unique stand of young oaks at the mouth of the Main Drain.

The slopes of the westerly levee of this reach have habitat values ranging from low to moderate for wildlife (species similar to other levee slopes in the Natomas Area). The uplands from Arcade Creek downstream to El Camino Avenue, on both the landside and waterside levee slopes, are of low value to wildlife because they are vegetated with annual grasses and are burned periodically. The wildlife value of the levee slopes (El Camino Avenue to Northgate Boulevard, Northgate Boulevard to the Garden Highway intersection, downstream to the mouth of the Main Drain)

increases as riparian forest is found adjacent to and/or on the levee slopes, and the levees are not burned.

ENDANGERED SPECIES

Federally Listed Species

Bald Eagle FE, SE
Haliaeetus leucocephalus

Although there are no recent or historical reports of bald eagles nesting in the Natomas Area, Detrich (1986) reports that bald eagles historically nested along the Sacramento River near Sacramento during the Gold Rush era. Therefore, at least during and prior to this period, it is reasonable to presume that bald eagles historically nested all along the Sacramento and American Rivers and major stream corridors adjoining the Natomas region.

Today, intensive human use and the almost continual human presence and activities in the Discovery Park area, the Natomas interior, Yolo and Sacramento Bypasses, may be important disturbance factors adversely affecting bald eagles nesting in these areas. Nonetheless, bald eagles do occasionally pass through and may stop over in the area during the winter. Elsewhere in the Central Valley, wintering bald eagles forage on waterfowl, which would be the primary attraction for the species in the Natomas area. The most suitable areas for roosting and stopovers would be the more isolated and least urbanized portions of the Natomas Area close to waterways such as the extreme north end along the Natomas Cross Canal, and in the east along the wider portions of Dry Creek.

Peregrine Falcon FE, SE
Falco peregrinus

Peregrine falcons are occasional winter visitors to the Natomas Area. This species feeds entirely on birds, especially larger birds such as shorebirds and waterfowl. The most suitable areas for peregrines are the more isolated portions where habitat conditions attract large numbers of their prey species.

Valley Elderberry Longhorn Beetle FT
Desmocerus californicus dimorphus

As part of the American River Watershed Investigation, reconnaissance level surveys were conducted for the valley elderberry longhorn beetle in the Natomas, Fremont Weir and Yolo and Sacramento Bypass areas. Maps of suitable elderberry beetle habitat were prepared for the American River Watershed Investigation using the presence of elderberry bushes as an

indication of habitat suitability. These maps were provided to the Corps to assist their preparation of a biological assessment for the project in compliance with the Endangered Species Act.

Elderberry shrubs commonly occur on the levee slopes along the Sacramento River, the Discovery Park region of the American River Parkway, and along the larger drainages within the Natomas region. Elderberry bushes are common in upland portions of the Fremont Weir and localized sites of the Yolo and Sacramento Bypasses wherever woody riparian uplands occur. They also occur along the larger drainages to the east and north of the Natomas Area including Dry Creek, Pleasant Grove Creek and the Natomas Cross Canal and East Main Drain. Although few elderberry plants occur within the interior areas of Natomas, as a consequence of the massive land alterations from agriculture and localized urbanization, substantial portions of the existing agricultural lands are easily restorable to wooded riparian habitats including elderberry thickets.

Palmate-bracted Bird's Beak SE, FE
Cordylanthus palmatus

This annual herb typically grows in saline-alkaline soils (Pescadero and Solano soil series) of seasonally flooded lowlands (elevation 0-100 feet). Plants frequently grow amid relatively undisturbed alkali sink scrub vegetation, including pickleweed, iodine bush, and salt grass.

Only four populations of this species exist. A small population near Woodland is the closest known site to the project area. This site may be threatened by a proposed target range development by the Woodland City Police Department.

The nearest known occurrence is just a few miles northwest of the study area near Woodland in Yolo County. Similar soil series and seemingly suitable seasonal wetlands occur in the Natomas and Rio Linda areas. These areas are being surveyed by the Corps based on reconnaissance of the area by Service personnel. Results of the survey will be detailed in a biological assessment report.

Other Species of Concern

Eleven additional species of concern, including three State-listed species, one of which is a Federal candidate species, and eight additional Federal candidate species were identified as occurring or potentially occurring in the Natomas region.

Swainson's hawk ST
Buteo swainsoni

The Swainson's hawk historically was as abundant in California as the red-tailed hawk (Schlorff and Bloom 1984). Dramatic declines in the species' distribution and abundance in California coincide with the documented rapid conversion of riparian habitats and adjoining grasslands to agriculture and urban development. These documented declines prompted the California Fish and Game Commission to designate the Swainson's hawk a threatened species under the California Endangered Species Act in 1985.

Eighty percent of the California Swainson's hawk breeding population uses the riparian system of the Sacramento River for nesting habitat, hence, the river is one of the most important nesting areas for the hawk in California (Estep 1989a). Nest tree species most commonly used by the Swainson's hawk in the Central Valley are cottonwood (Populus fremontii), valley oak (Quercus lobata), and black walnut (Juglans hindsii); along the Sacramento River, the cottonwood is the dominant tree species (Estep, 1989a). Approximately 98 percent of the riparian forest previously existing in the Central Valley has been removed; much of this has been due to agricultural conversions. The foraging behavior of the hawk in the Central Valley has developed as a result of the changes to this agricultural system. According to Estep (1989b), prey density and availability change with the cycles of crop planting, growth, and harvesting in each crop type within the Central Valley. The hawk's foraging behavior is in response to these cycles, which also probably increases their foraging effectiveness (Estep 1989b).

Both foraging and nesting habitat for the Swainson's hawk exists throughout the Natomas Area, Yolo and Sacramento Bypasses, Fremont Weir, and areas to the east and north. The total amount of suitable nesting and foraging habitat, however, is becoming increasingly limited in the South Natomas area as a consequence of the continuing urban development there. Additional constraints in this area include rapid urbanization and the associated rapidly increasing levels of human activities (especially during the spring-summer nesting season) within the remaining areas of suitable habitat. Areas such as Discovery Park, and along the Sacramento River are becoming more intensely affected.

The Natomas region (especially that portion north of the urbanizing South Natomas area), provides the most extensive remaining suitable nesting and foraging habitat for this species in the watershed study area. This is a consequence of its largely open, agricultural condition and the extensive availability of woody riparian forests and woodlands along the

many waterways of the area that adjoin large expanses of open grasslands, rice fields, and other suitable foraging habitats. Those portions of the Natomas Area that offer the most suitable mix of habitats include the entire western boundary along the Sacramento River, the open rural and agricultural lands, riparian corridors along Dry and Pleasant Grove Creeks, Natomas Cross Canal, and the Fisherman's Lake area. These areas typically present the appropriate mix of suitable habitat (dense riparian forest) and foraging areas (adjoining large grasslands, row crops and open grain fields).

Land-use that includes mainly alfalfa, lightly grazed dryland pasture, or other cover-types with continually available and adequate prey populations, is generally highly compatible with Swainson's hawk foraging needs (Estep 1989b). A study done by Estep (1989b) showed the relative important of 10 agricultural habitats based on preference data gathered on 12 radio tagged Swainson's hawks in the Central Valley (1986-87). The results are as follows:

CROP TYPE	RANK
Alfalfa	1
Disced field	2
Fallow	3
Dry-land pasture	4
Beets	5
Tomatoes	6
Irrigated pasture	7
Grains	8
Other row crops	9
Other	10

Alfalfa was preferred due to regular periods of increase in prey availability due to frequent mowing and flood irrigating, and its minimum vegetative cover; disced fields were used mainly for feeding on insects; fallow fields were popular due to low vegetative cover; dryland pasture ranked high since its physical characteristics are similar to historic grassland foraging habitat in the Central Valley; irrigated pasture was used during periods of flood irrigating; beet and tomato fields supported the largest prey populations; small prey populations and low prey availability made corn, sunflower, safflower, bean, and pepper crops less preferred; wheat and oat crops were infrequently used; and rice was never used (Estep 1989b).

From studies such as this, it is obvious that Swainson's hawks need foraging habitats that are compatible with their needs. It is also important to keep in mind that appropriate Swainson's hawk foraging habitat must be directly associated with suitable

nesting habitat, that is, they will not nest where suitable foraging habitat does not occur (Estep 1989b).

Bank swallow ST
Riparia riparia

Under existing regulated flow conditions and artificial bank maintenance programs, the most likely areas for the bank swallow within the Natomas region would be the few remaining cut bank areas along the Sacramento River, Dry and Pleasant Grove Creeks, the Natomas Cross Canal, and at the mouth of the American River at Discovery Park. A large cut bank exists on the north bank of the lower American River, across from the Rusty Duck restaurant, extending approximately 200-300 feet along the river edge. Suitable cut banks occur in all of the above areas at localized sites.

Giant garter snake ST, FC
Thamnophis gigas

The southern portion of the American River Basin located in Sacramento and Sutter Counties provides the most important habitat remaining in California for the giant garter snake. In Natomas, the extensive network of agricultural drainage canals, sloughs and waterways generally provide important habitat for the snake.

The giant garter snake inhabits sloughs, low gradient streams, and other waterways where it feeds on small fish and frogs. It finds shelter along banks and in adjacent uplands. It adapts well to man-made waterways as long as they have the primary requirements of (1) enough water during the active (summer) season to supply food and cover, (2) grassy banks for basking, (3) emergent vegetation for cover during the active season, and (4) high ground or uplands providing cover and refuge from flood waters during the dormant (winter) season. Most of these waterways are ideal for the snake because they are too small to support large predatory fish, but large enough to provide adequate food and cover.

The rice fields provide important habitat during late summer, when the fields are flooded and contain large numbers of mosquito fish (Gambusia affinis), Pacific treefrogs (Hyla regilla), and other food items. This food source may be especially important to newborn snakes.

Typical canals within the Basin are 10-20 ft wide with small levees on either side. A dirt maintenance road may be on one or both of the levees. The snake appears to favor those areas with two or more canals or ditches in parallel combination. Along the

canals there are periodic check dams and intersections with other canals. These structures provide habitat for the GGS in the form of deeper, food-holding water, and cover in the form of broken concrete, woody debris, and undercut banks. Most of the Sacramento River riparian corridor appears unsuitable based on the swift flow conditions and the presence of large numbers of predatory fishes in the main channel and contiguous backwater areas. In addition, the intensive, almost continual human use along the Sacramento River, in the South Natomas and Discovery Park areas, and the high proportion of densely shaded wetland habitat within these areas appears to further limit the potential for this species on the river side of the levees. This may account for the lack of sightings in the Natomas Cross Canal and NEMDC (upper section). Other areas that appear to offer excellent habitat for this species include the lower section of the NEMDC, where it enters the American River Parkway, and the lower portions of Arcade, Dry and Pleasant Grove Creeks.

California Spotted Owl FC 2
(*Strix occidentalis occidentalis*)

The spotted owl is found in extensive stands of mature and "old-growth" forests throughout mountainous regions of the American west. Timber harvest has resulted in extensive loss of spotted owl habitat. The northern subspecies (*S. o. caurina*), which occurs in northwestern California, Oregon, and Washington, was federally listed as threatened in July 1990. The so-called Mexican subspecies (*S. o. lucida*), which occurs in Arizona, New Mexico, and Colorado, was the subject of a recent petition to the Service requesting consideration for threatened status. The California subspecies (*S. o. occidentalis*), which occurs in the Sierra Nevada range and mountainous areas of southern California, is currently listed as a Category 2 candidate.

Breeding habitat for spotted owls usually occurs in multi-storied stands of large coniferous trees. These stands typically exhibit considerable decadence, providing owl nesting cavities and habitat for the small mammals which are the spotted owl's primary prey. Hardwoods are often present as a component in foraging habitat.

Research is currently underway on the status of the California spotted owl. U.S. Forest Service and University of California researchers have confirmed the presence of spotted owls in the American River watershed. Monitoring of radio-telemetered owls during autumn and winter months has revealed downslope migration to winter ranges below 3000 feet elevation in the Auburn/Placerville area (Laymon 1989). Key components of winter habitat remain undefined. Urbanization, logging, and firewood cutting may be affecting this wintering habitat.

A recent study by Laymon (1989) confirms the occurrence of several California spotted owls in the Auburn Dam drainages and near Folsom Lake. He found that they moved into the lower canyons (as low as 308m) during winter.

California lideriella FC1
Linderiella occidentalis

and

Vernal pool fairy shrimp FC1
Branchinecta lynchi

These two species are restricted to ephemeral freshwater habitats, such as vernal pools and swales in California. They are ecologically dependent on seasonal fluctuations in their habitat, such as the presence or absence of water during specific times of the year, the duration of water, and other environmental factors, that include specific pH levels, salinity, temperature, and quantities of dissolved oxygen. The Service has been petitioned to list these animals as endangered species and is presently preparing a 90-day finding.

California tiger salamander FC2, SC
Ambystoma tigrinum californiense

In the Natomas Area, likely areas for the tiger salamander would be the more seasonal wetland habitats which adjoin relatively undisturbed upland grassland or wooded habitats such as along Fisherman's lake or along the levees bordering the intermittent waterways of Dry and Pleasant Grove creeks, and the Natomas Cross Canal. Many of these areas are also suitable for the similarly adapted giant garter snake.

California Red-legged frog FC2, SC
Rana aurora draytoni

Sites of particular potential in the Natomas area include those suitable for the giant garter snake as well as any of the more shaded and isolated ponds along Dry, Arcade, and Pleasant Grove Creeks that lack bullfrogs or other large aquatic predators. The agricultural drainage canals, sloughs and channels of the Natomas interior may offer some suitable habitat for this species, although there are no historical records of its occurrence there. These drainage ways may be of low potential, however, because of the periodic clearing and dredging that occurs. The Sacramento Bypass and Fremont Weir, and along the eastern margin of the Yolo Bypass also may provide suitable habitats wherever permanent or seasonal ponds occur along with emergent vegetation.

Sacramento Valley tiger beetle FC2
Cicindela hirticollis abrupta

The intensive human use and associated recreational activities typically found on the sand bars and beaches of Discovery Park and along the Sacramento River during the spring and summer may limit the potential occurrence of the species in these areas. The lower portions of Dry and Pleasant Grove Creeks appear to offer the most suitable conditions for this species in the Natomas region.

Sacramento anthicid beetle FC2
Anthicus sacramento

Suitable sites for this species would include the same ones as for the Sacramento tiger beetle.

Valley sagittaria FC2
Sagittaria sanfordi

This herbaceous emergent aquatic plant typically occupies standing or slow-moving shallow waters of valley streams, ponds, channels, canals and sloughs. The historical distribution of this species included the above types of wetland habitats throughout portions of the Central Valley.

Many historical sites have been eliminated as a consequence of canal and slough maintenance activities and removal of emergent vegetation. Use of aquatic herbicides has undoubtedly eliminated many former populations in the agriculturally dominated Central Valley. In 1987, four populations were known to remain (C.E. Turner, USDA Biological Control Office, 1050 San Pablo Avenue, Albany, CA 94706, pers. comm. 1987). Surveys along the lower American River by Dr. Robert Holland and Ginny Dains confirmed two colonies, one near Watt Avenue and another near Rio Americana High School. It is highly possible that additional colonies occur in the wetlands and waterways of the Natomas region, especially along the extensive network of shallow drainage canals and sloughs associated with the agricultural areas. In addition, portions of Dry, Arcade, and Pleasant Grove Creeks and their tributaries appear to offer suitable flow and substrate conditions for this emergent plant in back water areas.

Bogg's Lake Hedge-hyssop SE, FC2
Gratiola heterosepala

This annual herb occurs in vernal pools and seasonally ponded areas on heavy clay soils at elevations from 0-300 feet. The species is distributed in scattered occurrences from Shasta County south to Fresno County. Several populations occur in

Lake, Madera, Placer and Sacramento Counties. Suitable habitat exists wherever vernal pools occur.

Most of the study area offers little potential for the species as a consequence of the extensive urban and agricultural development throughout the lowland sites of the study area. It is unlikely that vernal pools would occur in most of the Natomas Area because of the extensive agricultural and urban development that now exists there.

Within the Natomas Area the Bogg's Lake Hedge-hyssop is most likely to be found in undeveloped areas near Rio Linda, at the lower end of Dry Creek, and east of the NEMDC from the Dry Creek area to as far north as Pleasant Grove Creek. These areas support seasonal wetlands and vernal pools of seemingly suitable conditions.

Sacramento Orcutt Grass SE, FC1
Orcuttia viscida

This annual grass occurs in deep vernal pools in blue oak woodland or valley grasslands with sparse herb cover in pool bottoms. Elevations range from 0-300 feet. Within the Watershed study area suitable habitat is severely limited as a consequence of the extensive urban and agricultural development.

The species is known only from the vernal pools adjacent to Phoenix Field in Fair Oaks, pools near Rancho Seco and Grant Line Road in the southern part of Sacramento County. The most suitable sites in the Watershed study area exist along lower portion of Dry Creek and along the east side of the NEMDC.

Slender Orcutt Grass SE, FC1
Orcuttia tenuis

This annual grass grows in the bottoms of dried vernal pools (shallow or deep) in blue oak woodland or valley grasslands at elevations of 0-300 feet. Herb cover typically is sparse in pools with this species. The species is known from eastern Shasta County, northern Sacramento Valley and southern Sacramento County, as well as Lake County near Boggs Lake.

Within the Natomas Area the most likely locations include the vernal pools and seasonal wetlands at the lower end of Dry Creek and along the east side of the NEMDC up to and including the Pleasant Grove Creek area. Populations can and do exist where cattle grazing occurs.

Hispid Bird's-beak FC2
Cordylanthus _mollis_ v. _hispidus_

This summer-blooming, annual herb grows in alkali meadows and seeps usually on heavy clay soils, in association with salt grass, iodine bush, and other alkaline soil indicators. Elevation ranges between 0-300 feet. Plants are relatively easy to identify when in flower, usually between July and November. Closest known population occurs in the Roseville/Rocklin area growing in association with a saline spring. Similar soil types occur in the Natomas portions of the project area.

Dwarf Downingia FC3
Downingia _humilis_

This annual herb grows in vernal pools and moist grasslands immediately adjacent to such pools at elevations ranging from 0-300 feet. Flowering occurs from March to May. Surveys can be conducted secondarily, while looking for other vernal pool plants. Seemingly suitable habitat occurs around the lower end of Dry Creek where several vernal pools and seasonal wetlands occur in conjunction with county and private lands. Additional areas may also exist east of the NEMDC between Dry Creek and Pleasant Grove Creek. The probability of finding suitable vernal pool habitats elsewhere within the Natomas area is low because of the lack of proper soils and extensive land alteration from agriculture and localized urban development.

California Hibiscus FC2
Hibiscus _californicus_

This evanescent perennial shrub grows on the edges of freshwater marshes, ponds, rivers, and sloughs at elevations of from 0-50 feet. Typical habitat includes the wetted banks of backwater areas of rivers, streams and sloughs with non-erosive flows. The species is known to occur in parts of the Sacramento River, around Colusa, and in the Sacramento-San Joaquin Delta. The species is easily identified in flower (Aug - Sept.), and in full leaf, mid-June through September.

Although the hibiscus may have historically occurred in the areas around Natomas, there have been no recent documented occurrences, although this may simply be from lack of survey efforts. Most of the existing waterways of the Natomas Area appear unsuitable because of steep banks, intensive bankside maintenance, riprap and extensively altered flow conditions. Nonetheless, some suitable habitat may exist in the more isolated, relatively natural waterways around Fisherman's Lake and portions of Dry and Pleasant Grove Creeks.

Delta Tule Pea FC2
Lathyrus jepsonii ssp. jepsonii

This evanescent perennial herb grows in brackish water marshes, swamps canals, and along river banks in open areas away from dense shade. Elevations range from 0-20 feet. The species historically occurred within the Sacramento-San Joaquin Delta, portions of San Francisco Bay, along the San Joaquin River, and at a few other scattered sites in the San Joaquin Valley. The species is not known from within the project area although similar habitat occurs in the Natomas Area and at the mouth of the American River. Plants flower from April through June.

Greene's Legenere FC2
Legenere limosa

This annual herb grows in vernal pools at elevations from 5-200 feet. Plants flower from May through June and can be identified during flowering; however, because of their diminutive size, they can easily be overlooked.

WITHOUT THE PROJECT

VEGETATION

Under without-project conditions, existing vegetation and land use (Corps of Engineers 1990c) are expected to change. Lands in public ownership such as the American River Parkway are expected to maintain relatively natural conditions with continued high habitat values. Upland plant communities on public lands along existing flood control channels and levee banks, and higher terraces with oak woodland, should experience some declines in value with increasing human activities in surrounding areas. However, continued use of the channels as water conveyance features and maintenance of flood control levees should effectively preclude development. Increased maintenance activity (e.g., mowing, burning, brush clearance) is expected to degrade vegetation conditions over time as the area continues to develop.

Continued and significant loss of habitat on private lands in some localized portions (where structures can be floodproofed) of the Natomas Area is expected. The extent and rate of loss, however, will depend upon the land use planning processes and the land use decision-making environment within the local jurisdictions (e.g., City of Sacramento, and Sutter and Sacramento Counties).

Under without-project conditions, the conversion of existing agricultural and wild lands in the Natomas Area is expected to continue over the 104-year period of analysis (1990 to 2094). Of the estimated 41,400 acres of agricultural and wild lands in the area, about 16,500 acres are expected to be converted to residential, commercial and other related urban uses (Table 5).

Supporting Discussion

South Natomas. Of the remaining 1,550 acres in agriculture, about 120 acres will be developed by 1992. After 1992, without additional flood control, development in South Natomas is expected to halt. Localized flood proofing is basically deemed infeasible due to extreme low elevations. Consequently, most of the lands in agriculture will remain and attendant wildlife values will undergo little change.

North Natomas. Little growth will occur in North Natomas up to 1995 (Corps of Engineers 1989). There are about 600 acres along the East Levee Road in the northeast portion that are at higher elevations and thus more suitable for flood proofing. This area may be developed after 1995 for commercial use. Loss of these 600 acres would represent about 7 percent of the remaining lands

Table 5. Acres of Wildlife Cover Types (Existing and Without- Project)

Wetland Cover Types	Existing (acres)	Without-Project (acres)	Change (acres)
Marsh	760	457	- 303
Riparian forest	12	2	- 10
Scrub-shrub	633	381	- 252
Subtotal	1,405	840	565
Upland Cover Types			
Rice	12,936	7,776	- 5,160
Grain	10,371	6,234	- 4,137
Pasture	1,139	686	- 453
Grassland	2,895	1,749	- 1,146
Orchard	1,034	622	- 412
Row crop	11,628	6,989	- 4,639
Subtotal	40,003	24,057	-15,947
Total	41,408	24,896	-16,512

in agriculture. Without the project, no other significant growth is expected after 1995 other than along the East Levee Road (Corps of Engineers 1989). Vegetation on agricultural lands and along ditches, canals, waterways and other areas should remain generally in the same condition. The acreages and conditions of various cover types will depend largely on levee district maintenance practices, small project Corps permit actions and other local land use actions.

Sacramento Airport and Special Planning Area. Vegetation in the Sacramento Metropolitan Airport area will remain the same if maintenance practices remain unchanged and no new runway, parking or other structural areas are added. A 2,000-acre special planning area adjacent to the airport has advantageous elevation contours (i.e., about 20 feet elevation) similar to the airport. It is likely that this area will be commercially developed by the year 2010 even without the project. This would represent a significant loss of the remaining agricultural lands in the Natomas Area and attendant loss in wildlife values.

South Sutter County. Little growth in South Sutter County between 1990 and 1995 is expected (Corps of Engineers 1989). This does not, however, address or take into account development recently proposed by Sutter Bay Associates for a new city of

200,000 residents on 23,000 acres in South Sutter County within the project area.

About 350 acres are outside the flood hazard area and another 4600 acres would be suitable for floodproofing. Although the existing Sutter County General Plan and zoning provide only for agricultural use, future plan amendments likely will permit residential and commercial development. By the years 2010 and 2045, a 840-acre and 6,500-acre loss of agricultural lands, respectively, are expected (Corps of Engineers 1989, 1990c). This represents a 16 percent reduction in agricultural lands by 2010 and 43 percent reduction by the year 2045. Because about 94 percent of South Sutter County is presently in agriculture, there are broad, continuous expanses of various cover types including flooded rice fields, large canals, and waterways with attendant vegetation that is of highly significant value to wildlife. Continuous strands of riparian corridor along the Natomas Cross Canal, scrub-shrub along many of the smaller ditches and canals, huge expanses of rice and grain fields, and numerous rice checks in fields adjacent to these canals are of extremely high value to many wildlife species. The projected reductions in agricultural lands in South Sutter County by the year 2010 will have great impacts on vegetation and wildlife habitat.

In summary, without the project, significant agricultural acreage will be converted to urban uses (Corps of Engineers 1989). The attendant losses of vegetation and wildlife habitat will be significant. In South Natomas, about 120 acres will be developed by 1993. After this, conditions will remain relatively stable. Overall, by the year 2010, about 3 percent of the agricultural land will be displaced by urbanization in South Natomas, North Natomas, North Sacramento County, Sacramento Metropolitan Airport, Special Planning Area, and South Sutter County. By the year 2045, about 21 percent will be lost. By the year 2094, about 40 percent will be lost.

Development will fragment the remaining lands. Some of the vegetation along ditches, canals and waterways will be lost as they are drained and cement-lined. Although about 60 percent of agricultural lands will remain after 1993, natural vegetation remaining on these lands will be altered and of less value to wildlife.

FISH

Assuming that management of fishery resources remains the same as today, anadromous fish resources in the Sacramento River Basin will experience continued declines in the future. The existing losses of fish diverted into the Yolo Bypass through the Fremont Weir will continue. Urban growth in towns and cities in the

watersheds of these rivers will continue to reduce water quality, reduce stream flows, increase water temperatures, elevate non-point source contaminant discharges, and exacerbate other water quality and quantity problems. Efforts will be made to maintain water standards for fishery purposes including possible construction of better temperature control structures at Shasta Dam; however, water supply problems coincident with urban expansion and human population growth will likely override these efforts.

In the South Natomas, North Natomas, and South Sutter County areas, without increased efforts on the part of the City and County governments, resident fish populations will also continue to decline. Some losses will occur as agricultural drains, canals, and small farm ponds are filled and converted for urban land use; however, resident fish losses will probably not be noticeable. Other losses will occur in the larger creeks, canals and drains such as the NEMDC and Natomas Cross Canal, and Dry and Arcade Creeks where lowered water quality from increased contaminants, warmer temperatures, reduced flows, siltation and other degrading factors already have significantly reduced habitat values.

The anadromous chinook salmon resource in this area should not change significantly from existing conditions. Salmon will continue to migrate through the project as adults to reach upstream spawning areas and on their downstream journey as young to the ocean. Although some degradation of habitat will occur, only minimal adverse impact to salmon is expected as they typically move through the project area under higher flow conditions when water quantity and quality are best. The greatest impact will occur during dry and critical water years.

WILDLIFE

With the loss of about 12,000 acres of existing wetland and upland habitat due to development, wildlife inhabiting and frequenting the area will be impacted. Of great significance is the loss of wetlands (marsh, open water, riparian forest, and scrub-shrub), and seasonally flooded rice fields, row crops and grain fields (uplands). The loss of these habitat types will have a particularly significant adverse impact on migratory waterfowl and other water-associated birds that use these areas extensively. These losses will also adversely impact other wildlife such as raptors, songbirds, small mammals, and upland game birds. Most of the species would be displaced and eventually lost. Even species that are able to migrate to adjacent areas would be lost over time because most neighboring habitats are already at full carrying capacity.

WITH THE PROJECT
(200-Year Protection)

VEGETATION

Under with-project conditions, construction of the flood-protection facilities would directly impact 17 acres of wetland and 209 acres of upland habitat (Table 6). Wetland losses (emergent marsh) would occur for the most part along the alignment of the 2-mile-long drainage channel.

In addition to the direct construction impacts, implementation of a 200-year flood protection plan would significantly accelerate the conversion of 22,491 acres of wild and agricultural lands in this area to residential, commercial, and other related urban uses over that expected without the project (Table 6) (Corps of Engineers 1989).

The accelerated rate of conversion and the loss of an additional 22,914 acres would essentially eliminate much of the existing vegetative types in the area, except for those areas under public ownership or along the levee slopes and toe drains in the area. With-and without-project comparison of wildlife cover losses is illustrated in Table 7.

FISH

Construction and operation of a gated structure and pump station in the NEMDC upstream of the mouth of Dry Creek would have an adverse effect on chinook salmon and steelhead trout that use these waterways as migration corridors. Although the runs are small and episodic, any impediment such as a barrier or pump station would severely impact both upstream and downstream migrants. Both adults and juveniles could be blocked, delayed, or even diverted depending on gated structure location and pump operation.

Under with-project conditions, resident fish populations would continue to decline at an accelerated rate above that expected under without-project conditions. Over time, loss of the agricultural waterways, major canals and open drainages would result in declines of the resident fishery in Natomas. As residential and commercial dwellings encroach upon open waterways, water quality would be degraded, debris would accumulate in the channels and eventually the fishery would disappear. Existing conditions in the NEMDC and Arcade Creek demonstrate the adverse effects of urban encroachment.

Table 6. 200-YEAR PROTECTION

Wildlife Cover Acreage Losses[1/]

Wetland	C*	LU*	Ttl
PEM	17	418	435
PFO	0	2	2
PSS	0	350	350
Subtotal	17	770	787
Upland			
Rice	29	7,163	7,192
Grain	125	5,743	5,868
Pasture	13	629	642
Grassland	42	1,175	1,217
Orchard	0	573	573
Row	0	6,438	6,438
Subtotal	209	21,721	21,930
Total	226	22,491	22,717

*Construction Impacts *Land Use Impacts

1/ With-project losses represent the difference comparing with- and without-project acreages at the end of project life (100 years).

WILDLIFE

Providing 200-year flood protection to the Natomas Area would result in a major and highly significant loss of wildlife habitat over the life of the project. Much of this loss is attributed to floodplain development that would occur as a result of increased flood protection. Once flood control features are in place, the rate of development would be accelerated and wildlife habitat and populations would rapidly decline. To some extent, land speculation and planning changes are already occurring with the anticipation that additional flood protection will occur (Sacramento News and Review 1990).

Construction would last about 2 years and during that time loss of wildlife habitat would be accelerated. Efforts would be made to minimize loss of wetland habitat by avoiding construction in the emergent marsh and open water zones.

Although levee construction and other facilities would result in the direct loss of 17 acres of wetland and 209 acres of upland

Table 7. 200-YEAR PROTECTION

Acres of Wildlife Cover Types[1/]

Wetland Cover Types	Without Project (acres)	With Project (acres)	Loss (acres)
Marsh	457	22	435
Riparian forest	2	0	2
Scrub-shrub	381	31	350
Subtotal	840	53	787
Upland Cover Types			
Rice	7,776	584	7,192
Grain	6,234	366	5,868
Pasture	686	44	642
Grassland	1,749	532	1,217
Orchard	622	49	573
Row Crop	6,989	551	6,438
Subtotal	24,056	2,126	21,930
Total	24,896	2,179	22,717

1/ Based on melded Corps of Engineers' land use projections of 6/13/89 and 8/31/90.

habitat (Table 6), the urbanization of 770 acres of wetlands and 21,721 acres of uplands would have a substantially greater impact on wildlife use and values of the area. The combined loss of 22,717 acres of wildlife habitat (787 acres of wetland and 21,930 acres of uplands) would be a highly significant increase in wildlife habitat losses over those expected without the project. A virtual total loss of wetland and upland wildlife habitats would occur in the flood-protected areas.

The most significant impact would result with the loss of 787 acres of wetlands, 5,868 acres of grain fields, and 7,192 acres of seasonally flooded rice fields (uplands). The loss of these habitat types would virtually eliminate the use of the Natomas area by thousands of migratory waterfowl and other water-associated birds -- birds protected under the Migratory Bird Treaty Act. Although some habitat for these species is available in adjacent areas, 90 percent of the wetlands along the Pacific Flyway in California have been lost and the remaining areas are

diminishing rapidly. Loss of such large acreages in the Natomas Area would further fragment the migratory corridor and likely reduce values of nearby migratory bird habitat in the Yolo and Sutter Bypasses. This also would result in the crowding of birds into smaller and smaller areas, significantly increasing the potential for losses from disease and predation.

The loss of wetlands would also eliminate important resting, nesting and/or foraging areas for songbirds, raptors, small mammals, amphibians and reptiles that inhabit the Natomas Area.

Loss of riparian forest and scrub-shrub habitat would reduce populations of species such as the black-shoulder kite, red-shouldered hawk, woodpecker, flicker, yellow warbler, gray squirrel and others.

Loss of 21,930 acres of upland would also result in major wildlife habitat losses and attendant wildlife population reductions. Much of these acreage losses are in rice and grain fields which support large populations of migratory ducks, geese, swans, raptors, herons, and egrets.

Loss of 5,868 acres of grain field and 6,438 acres of row crops would generally eliminate the rodent populations and small prey which are the primary food source for raptors such as the State-listed Swainson's hawk and others like the red-tailed hawk, black-shoulder kite and American kestrel. Existing raptor nesting activity along the Natomas side of the Sacramento River may be greatly diminished or eliminated due to lack of a nearby food source. In addition, ring-necked pheasant, mourning dove and California quail populations would be lost.

Most wildlife species inhabiting the Natomas Area would be lost or displaced, except along the fringes of the area (e.g., levee slopes, toe drains), and those areas under public ownership (drains and canals). Wildlife species that are able to migrate to adjacent areas would eventually be lost because those areas would already be occupied at full carrying capacity. In addition, wildlife values of those areas are expected to diminish with development because of significantly increased human disturbance and intensified maintenance practices.

DISCUSSION

RESOURCE CATEGORIES

Our recommendations are based on the Fish and Wildlife Service's Mitigation Policy (Federal Register 46:15, January 23, 1981) which provides internal guidance for establishing appropriate

compensation for projects under our purview. Under this policy, fish and wildlife habitat is divided into four Resource Categories to assure that recommended compensation is consistent with fish and wildlife values involved. The Resource Categories cover a range of habitats from those considered to be unique and irreplaceable to those believed to be of relatively low value to fish and wildlife. This policy does not apply to federally listed endangered or threatened species.

During impact assessment, specific habitat types that may be impacted by the project are identified, and evaluation species which utilize each habitat type are selected. Selection of evaluation species can be based on any of several rationales, including (1) species known to be sensitive to specific land and water use actions, (2) species that play a key role in nutrient cycling, or energy flow, (3) species that utilize a common environmental resource, or (4) species that are associated with Important Resource Problems as designated by the Director of the Fish and Wildlife Service, such as anadromous fish and migratory birds. Habitat value determinations are based on the importance of the habitat types found in the project area to the selected evaluation species and the relative scarcity of the habitat types.

The evaluation species selected to determine the Resource Category of the aquatic habitat in the Natomas Area were chinook salmon and steelhead trout that pass through the area on their annual migration (upstream and downstream), and warmwater game and non-game fish species that inhabit the canals, ponds, drains and other waterways. The large waterways such as the Sacramento and American Rivers are of major importance to anadromous and other game and non-game species. The smaller waterways are of moderate value for small populations of chinook salmon and steelhead trout, serving only as migration corridors. Under existing conditions, most of the canals, drains, ponds and other waterways are of moderate to low value to warmwater fish species due to degraded water quality and inconsistent flows. Therefore, in accordance with the Mitigation policy, we have designated the aquatic habitat of the Natomas Area as Resource Category 3. Our mitigation goal under this category is no net loss of habitat value while minimizing loss in in-kind habitat value.

The evaluation species selected to determine the Resouce Category of wetlands were migratory waterfowl, great blue heron, wood duck, yellow warbler, black-shoulder kite, downy woodpecker, sora, western flycatcher, northern oriole, mink and red-legged frog. Riparian forest, emergent marsh and scrub-shrub vegetation provide important nesting, resting and/or feeding areas for these species. The wetlands provide important wintering habitat for migratory waterbirds. Because riparian and wetland habitats are

of high value to the evaluation species and are relatively scarce or becoming scarce in the region and in California, designated the riparian and wetland habitats as Resource Category 2. Our mitigation goal under this category is that no net loss of in-kind habitat value occur.

The evaluation species selected to determine the Resource Category of upland habitat were short-eared owl, ring-necked pheasant, California vole, and American kestrel. Most of the upland habitat acreage impacted is under cultivation. There are some upland areas, however, which are fallow fields and uncultivated areas next to levees. Although this habitat type is heavily used by wildlife, it is under cultivation or otherwise disturbed, and is common throughout the region and the State. Therefore, we have designated this habitat type as Resource Category 3. Our mitigation goal is no net loss of habitat value while minimizing loss in in-kind habitat value.

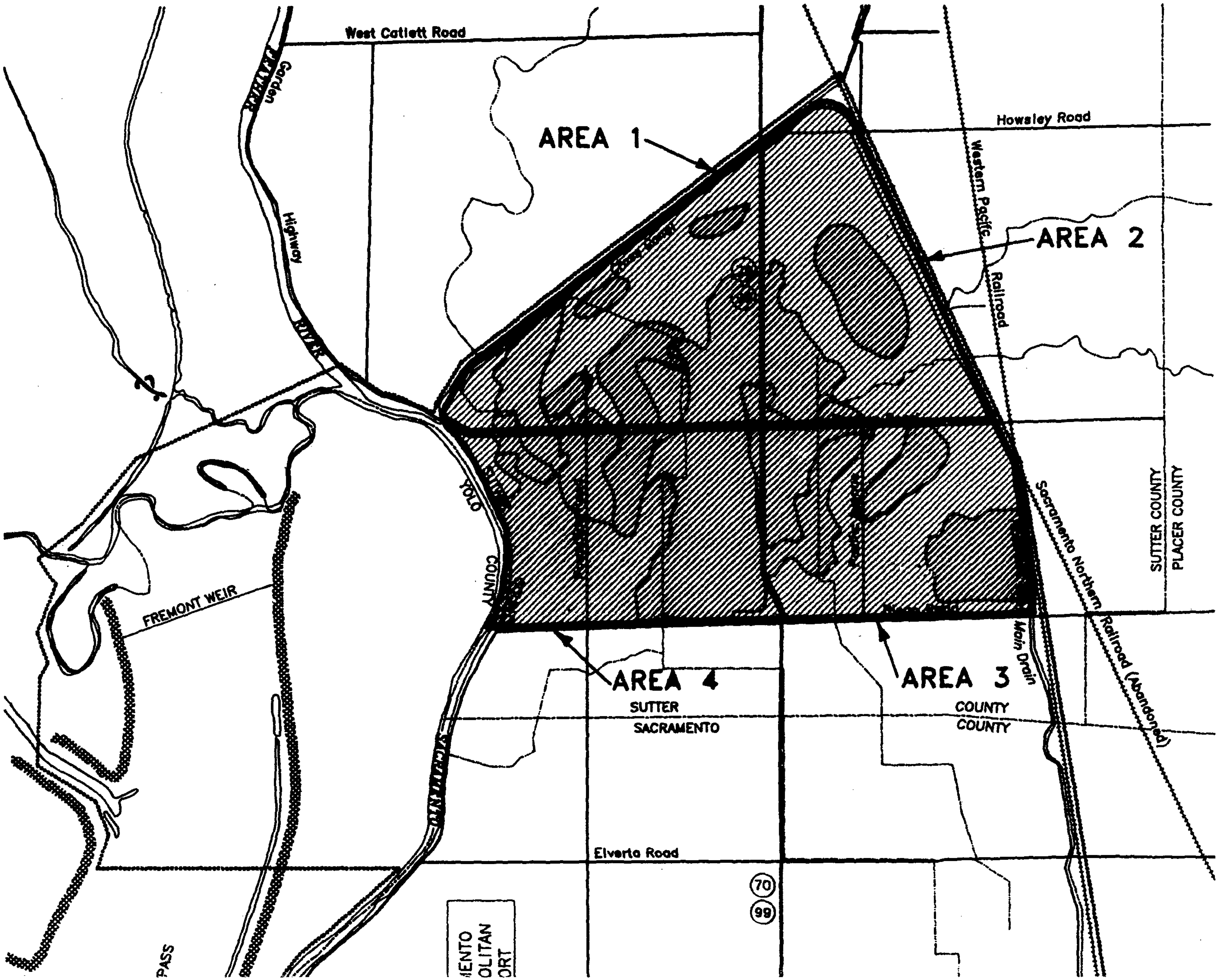
The evaluation species selected to determine the Resource Category of seasonally flooded rice fields and grain fields were wintering migratory waterfowl and other waterbirds. The vast areas of seasonally flooded fields provide essential habitat for wintering migratory waterfowl and other waterbirds. They also provide important foraging habitat for many raptor species. Because large acreages of rice and grain fields are seasonally available to waterfowl, we placed them in Resource Category 3.

MITIGATION

To mitigate construction and operation impacts of the gated-structure and pump station on migrating chinook salmon and steelhead trout in the NEMDC, fish protective measures would be required. To minimize construction impacts on salmon and steelhead, in-channel construction activity should be limited to the June 1 to August 31 period. Also, to minimize the loss of salmon and steelhead because of weir and pump operation, and possible delay or blockage of migration, fish screens and other protective devices would be necessary.

The design and cost of screens and other protective measures needed have not been determined at this time. However, any fish screen design or other protective measures would require coordination with, and approval by, the Fish and Wildlife Service and the California Department of Fish and Game.

To mitigate the loss of 787 acres of wetlands and 21,930 acres of upland habitat with-the-project, 17,650 acres in the Natomas Area would be required for management as a wetland/upland complex. Potential compensation areas that would meet management needs are shown in Figure 25. Areas 1 and 4 were selected for our Habitat


West Catlett Road
Garden
Highway
RIVER
Howsley Road
AREA 1
AREA 2
Western Pacific
Railroad
Sacramento Northern Railroad (Abandoned)
SUTTER COUNTY
PLACER COUNTY
YOLO
COUNTY
FREMONT WEIR
AREA 4
AREA 3
Main Drain
SUTTER
SACRAMENTO
COUNTY
COUNTY
Elverta Road
70
99
PASS

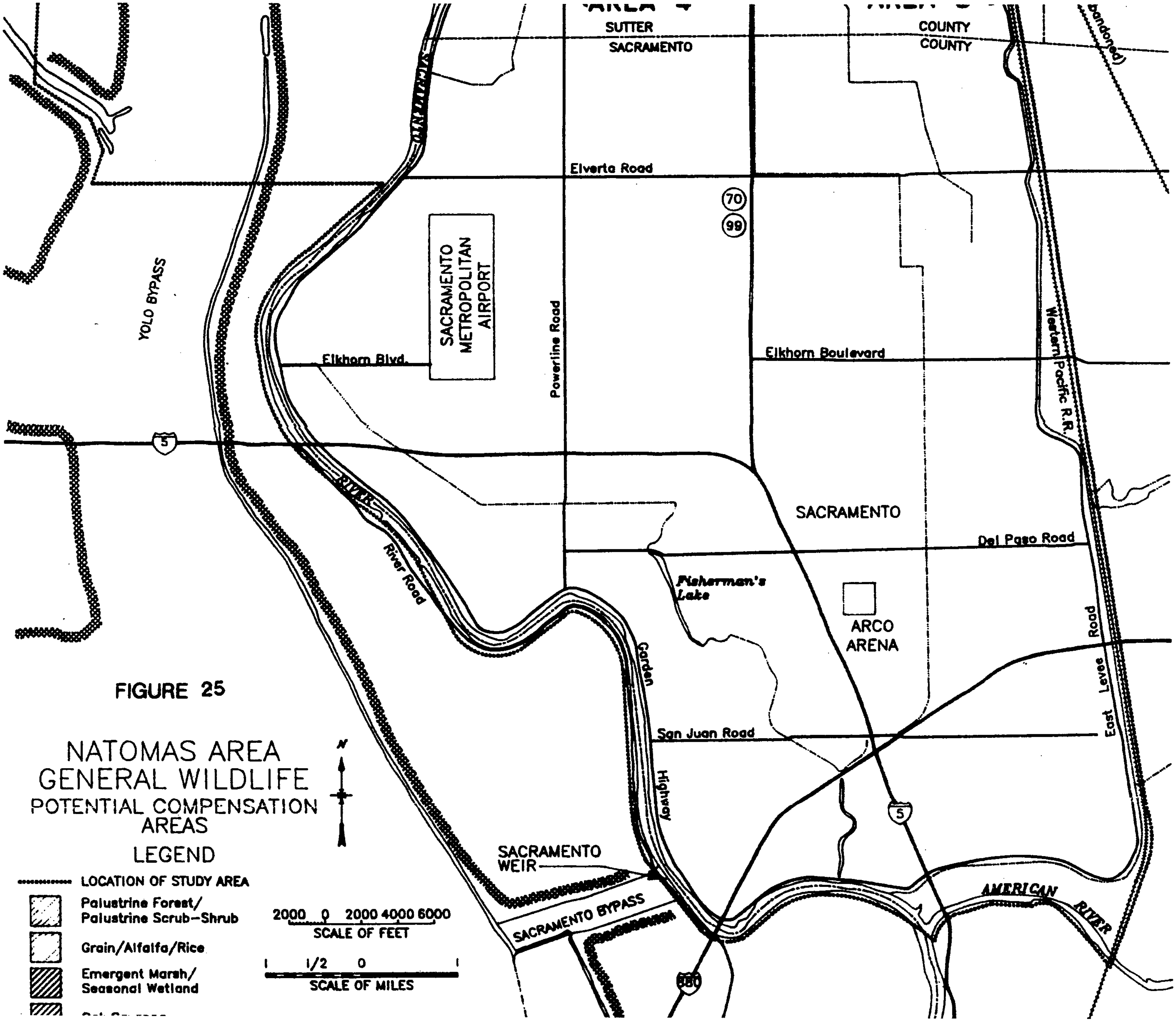


FIGURE 25

NATOMAS AREA
GENERAL WILDLIFE
POTENTIAL COMPENSATION AREAS

LEGEND

LOCATION OF STUDY AREA
Palustrine Forest/ Palustrine Scrub-Shrub
Grain/Alfalfa/Rice
Emergent Marsh/ Seasonal Wetland

2000 0 2000 4000 6000
SCALE OF FEET

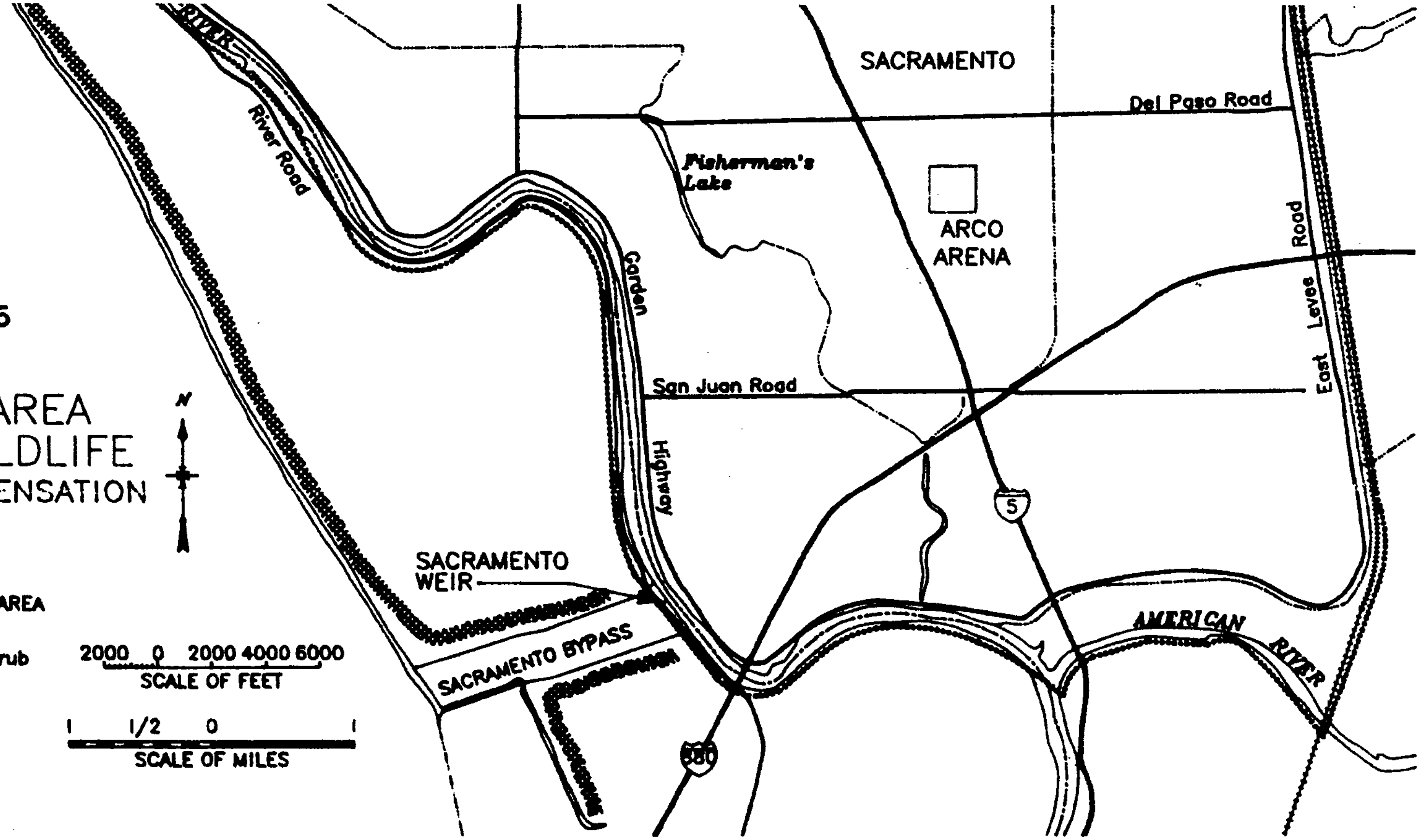
1/2 0
SCALE OF MILES

2

3

FIGURE 25

NATOMAS AREA GENERAL WILDLIFE POTENTIAL COMPENSATION AREAS



LEGEND

- LOCATION OF STUDY AREA
- Palustrine Forest/ Palustrine Scrub–Shrub
- Grain/Alfalfa/Rice
- Emergent Marsh/ Seasonal Wetland
- Oak Savanna

Area 1 Acreages	
Palustrine Forest/ Palustrine Scrub–Shrub	721.79
Grain/Alfalfa/Rice	511.98
Emergent Marsh/ Seasonal Wetland	955.91
Oak Savanna	1366.44
Subtotal	3556.12

Area 2 Acreages	
Palustrine Forest/ Palustrine Scrub–Shrub	669.33
Grain/Alfalfa/Rice	88.28
Emergent Marsh/ Seasonal Wetland	563.56
Oak Savanna	1814.24
Subtotal	3135.41

Area 3 Acreages	
Palustrine Forest/ Palustrine Scrub–Shrub	798.57
Grain/Alfalfa/Rice	877.60
Emergent Marsh/ Seasonal Wetland	449.97
Oak Savanna	1416.46
Subtotal	3542.60

Area 4 Acreages	
Palustrine Forest/ Palustrine Scrub–Shrub	298.97
Grain/Alfalfa/Rice	1465.49
Emergent Marsh/ Seasonal Wetland	2164.06
Oak Savanna	104.54
Subtotal	4033.06

Grand Total 14,267.19

Evaluation Procedures (HEP) analysis since they possess adequate acreage, soils, and a preferred strategic location for wildlife habitat restoration. Management measures in these areas would include (1) the excavation and contouring of lands to establish wetland cover (emergent marsh, scrub-shrub, palustrine forest), and upland cover (oak savannah/grassland, rice/grain/pasture); (2) adequate year-round supply of good-quality water to satisfy the wetland cover needs; (3) sites at least 250 meters from any significant human disturbance; (4) soils and other site features suitable to support cover in the following ratios: emergent marsh 42%, palustrine forest 0.5%, palustrine scrub-shrub 13%, oak savannah/grassland 20%, and rice/grain/alfalfa 8%; (5) replanting with native species; (6) watering of riparian and upland plantings for a minimum of 6 years, or until the plantings are well established; and (7) monitoring for a period of at least 20 years beyond the initial establishment period.

Long-term monitoring is indicated because of recent findings regarding the low success of mitigative plantings (riparian and other wetlands). Without long-term monitoring, the Fish and Wildlife Service might have to reassess assumptions used for this analysis, using the most recent data available. This could significantly increase the mitigation area required. Annual cost for monitoring is estimated at $27,000.

Area 4 is bounded on the west by the Sacramento River, on the east by State Route 99, on the south by Riego Road, and on the north by Sankey Road. Area 1 is bounded on the north by the Cross Canal, on the east by State Route 99, on the west by the Sacramento River, and on the south by Sankey Road. Well-drained, moderately well-drained, and poorly drained loam and clay soils are distributed throughout the area (Appendix 6). The North Main Drainage Canal conveys water through the area from the Natomas Cross Canal and discharges into the Sacramento River south of Riego Road. Currently, Area 4 lands are in rice (79%), grain (7%), pasture (4%), row crops (10%), grass (1%), and idle or fallow (11%). Area 1 lands are in rice (86%), pasture (1%) and row crops (13%).

Site layout would be designed to optimize habitat for those guilds of species represented in our HEP evaluation. Some large open-water areas would be included in the more northeasterly portion of the site away from airport flight paths to regain values lost in the seasonally flooded rice fields.

Areas would be planted with native trees such as Fremont cottonwood; valley, interior live, blue, and oracle oak; and shrubs such as sandbar, yellow, arroyo, red, Goodding's and dusky willow; elderberry; and vines such as blackberry and wild rose.

Emergent vegetation would consist of _Typha_ and _Scirpus_ spp. The density of plantings should be as follows:

Oaks	100/acre
Cottonwoods	200/acre
Willows	400/acre

Shrubs that will become trees would be started as 1-gallon stock. Others that remain shrubs, e.g., willows, can be started as cuttings or root stock.

All plantings would require watering and other maintenance for a minimum of 6 years, or until the vegetation has become established. The most efficient and reliable method of watering is a drip system. The estimated cost to establish 17,650 acres of replacement habitat comprised of wetland and upland cover types is $171,675,000. Average annual replacement, maintenance and operation cost is estimated at $8,825,000.

Since this area would be surrounded by urban developments, four-foot high, four-strand barbed wire fencing would be required to protect the habitat values. Public access would be provided through gated openings at strategic locations. This would ensure control for law enforcement, public safety, and other purposes. Fencing cost is estimated at $200,000.

FISH AND WILDLIFE HABITAT CONSERVATION OPPORTUNITIES

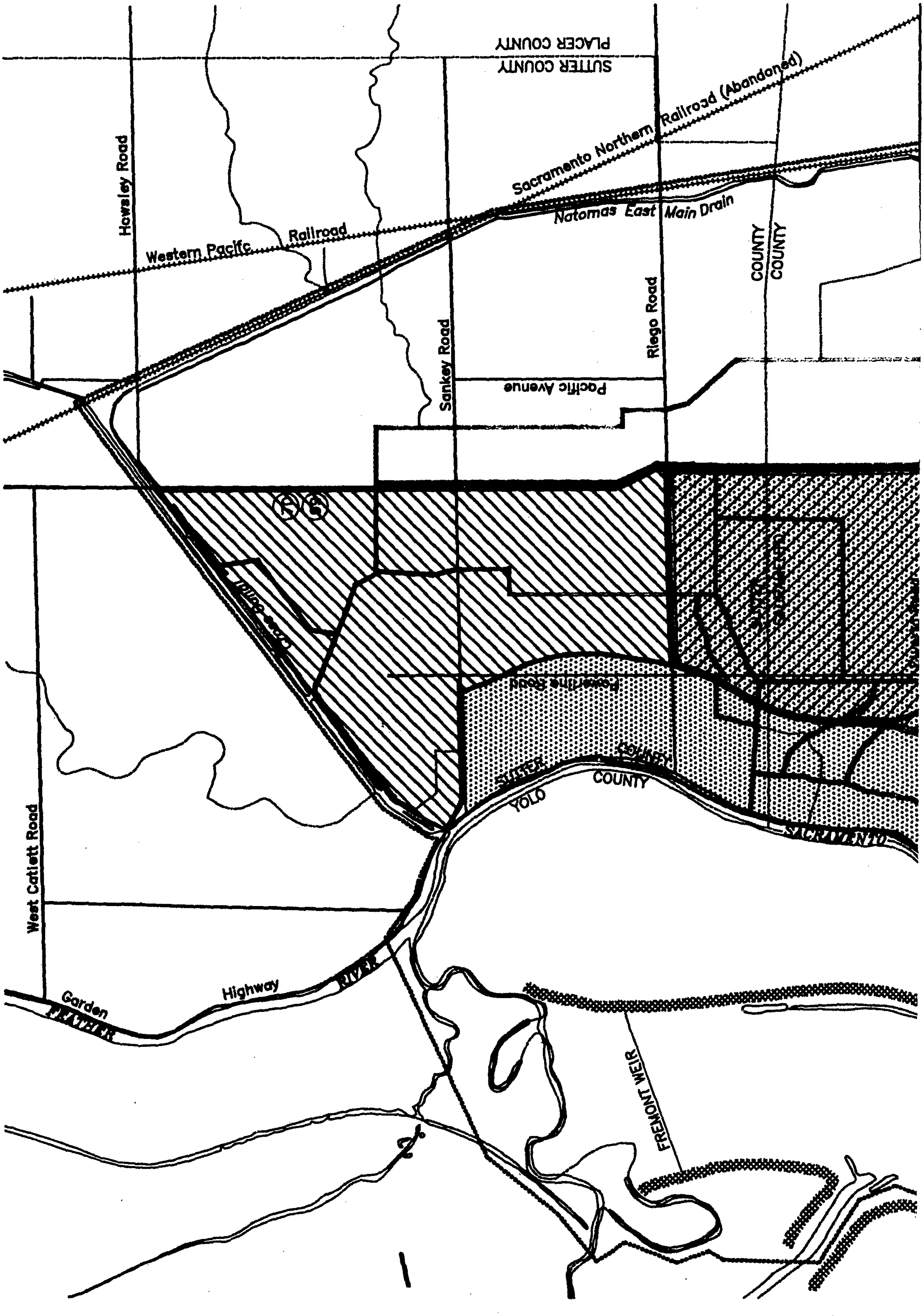
We believe there are many excellent opportunities in the Natomas Area to reduce needed mitigation by restoring and regaining lost wetland habitat. Prior to construction of the Federal levees that surround Natomas, floodwaters from winter rains regularly overflowed the foothill streams of Pleasant Grove, Curry, Dry, Arcade and other creeks to create large expanses of flooded lands throughout Natomas. Dense stands of tules (rushes) and marsh vegetation covered the basin floor. Waterfowl, raptors, rodents, snakes and other marsh species were abundant. Construction of levees around Natomas facilitated the conversion of these wetlands for agricultural use, thus greatly diminishing their value to fish and wildlife. Levee improvement proposed in the American River Watershed Investigation would further diminish the remaining resources, unless concerted efforts are made to protect and restore a portion of the lands in the project area. Such efforts should focus on freshwater wetland restoration, and setting aside management areas for migratory waterfowl, federally listed valley elderberry longhorn beetle habitat, State-listed Swainson's hawk habitat and giant garter snake habitat. Although most of the Natomas Area is in agriculture there are measures available to accomplish protection and restoration of wildlands while retaining significant acreage of agriculture. More

specifically, we propose that a plan to accomplish freshwater wetland restoration, and habitat development for valley elderberry longhorn beetle, Swainson's hawk, giant garter snake and other species be developed as a cooperative venture between public agencies, resource interest groups, and private entities if appropriate. We propose that the California Central Valley Habitat Joint Venture be the facilitator for accomplishing plan development and implementation. Elements in the plan should address wetlands restoration, Federal- and State-listed species, and fisheries restoration. Specific measures that should be included in the plan are described below and shown in Figure 26.

Sutter County - The Corps of Engineers and project sponsors should acquire fee title on 4,500 acres of agricultural land in south Sutter County and fund a management program primarily for migratory waterfowl. Acquisition of lands in rice production offers the most cost-effective means of wetland restoration due to minimal landscaping requirements and readily available water supply. Additionally, acquire a conservation easement on 1,200 acres of agricultural land in south Sutter County and manage them to optimize habitat for the State-listed giant gartersnake. Restoration of a wetland/upland complex would mutually improve habitat values for giant gartersnake, Swainson's hawk and other wildlife.

Sacramento County - Acquire a conservation easement on 9,400 acres of agricultural land in Sacramento County to restore wetlands and to optimize habitat for the giant gartersnake, valley elderberry longhorn beetle and other fish and wildlife. Restoration planning would be coordinated with the Sacramento Metropolitan Airport's need to establish a large undeveloped buffer zone around airport properties and take into account constraints due to the Airport's flight paths and expansion plans. Open water areas would be confined to narrow channels, small ponds and sloughs to avoid concentrations of waterfowl and potential bird strike hazards.

Inclusion of wetland/upland habitat in the buffer zone would help to offset future impacts on giant gartersnake and other general wildlife species as Natomas develops. Another opportunity exists for wetlands restoration in the Fisherman's Lake area which is being considered in county planning for a drainage retention basin. Fisherman's Lake is considered to be of high habitat value for giant gartersnake and other wildlife. Combining establishment of a greatly expanded wetland/upland complex that would serve as a temporary seasonal flood retention basin would


SUTTER COUNTY
PLACER COUNTY
Sacramento Northern Railroad (Abandoned)
Howsley Road
Western Pacific Railroad
Natomas East Main Drain
Sankey Road
Riego Road
COUNTY
COUNTY
Pacific Avenue
West Catlett Road
Garden Highway
FEATHER RIVER
SUTTER COUNTY
YOLO COUNTY
SACRAMENTO
FREMONT WEIR

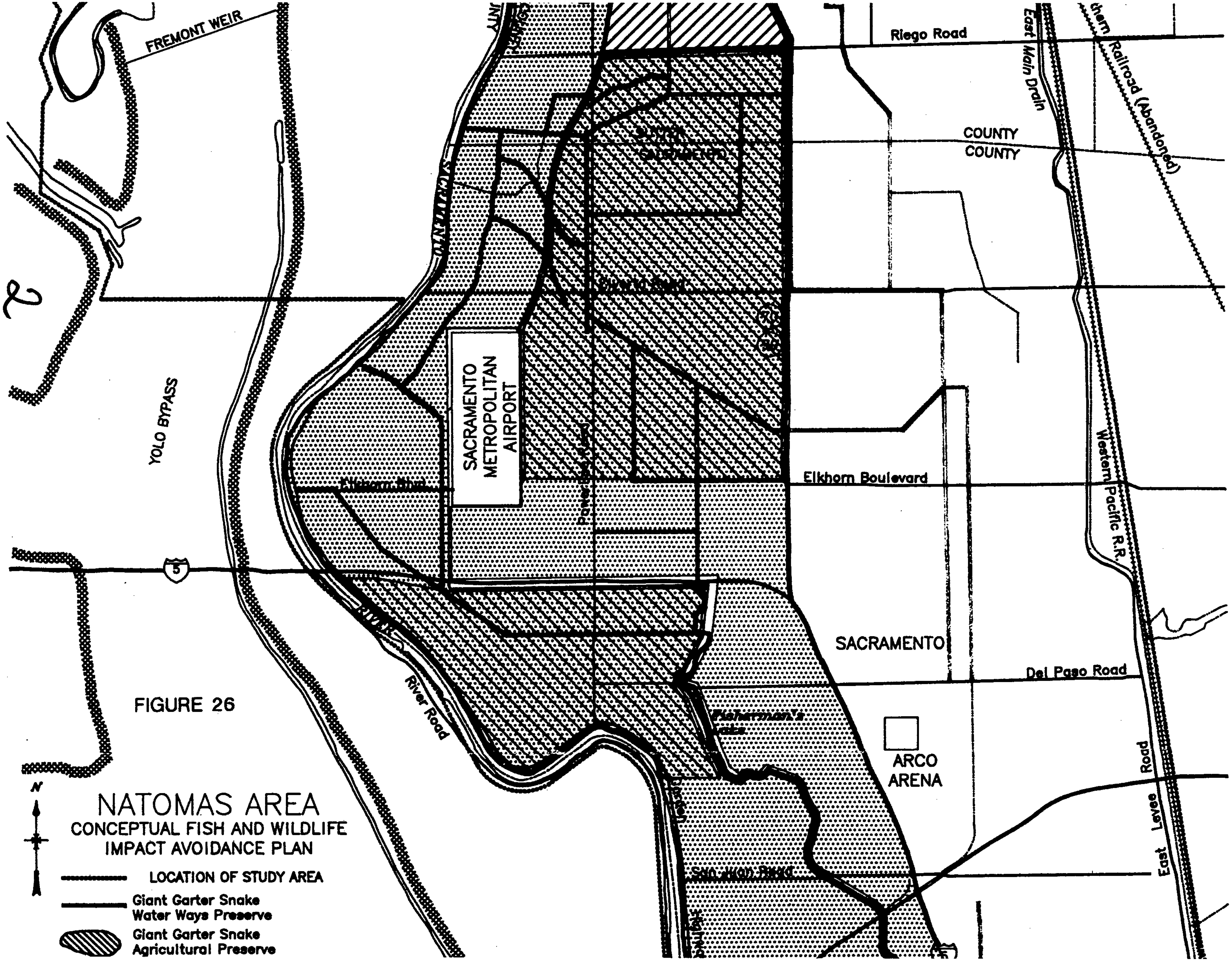
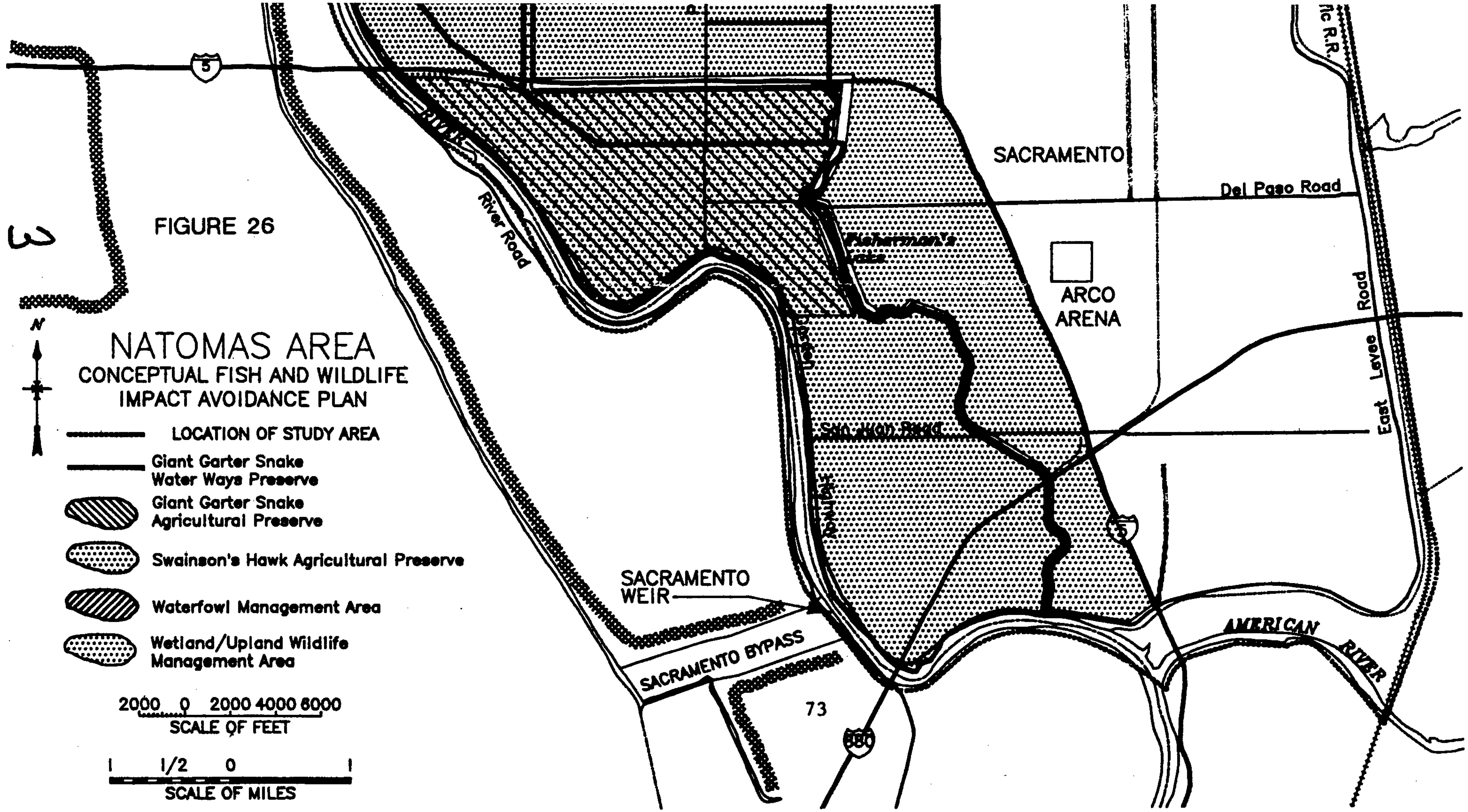


FIGURE 26

NATOMAS AREA
CONCEPTUAL FISH AND WILDLIFE
IMPACT AVOIDANCE PLAN

2


3
FIGURE 26
NATOMAS AREA
CONCEPTUAL FISH AND WILDLIFE
IMPACT AVOIDANCE PLAN
LOCATION OF STUDY AREA
Giant Garter Snake Water Ways Preserve
Giant Garter Snake Agricultural Preserve
Swainson's Hawk Agricultural Preserve
Waterfowl Management Area
Wetland/Upland Wildlife Management Area
2000 0 2000 4000 6000
SCALE OF FEET
1 1/2 0 1
SCALE OF MILES
N
5
River Road
RIVER
SACRAMENTO
Del Paso Road
ARCO ARENA
East Levee Road
AMERICAN RIVER
SACRAMENTO WEIR
SACRAMENTO BYPASS
73
Fisherman's Lake

benefit fish and wildlife and demonstrate sound environmental planning.

Swainson's Hawk Habitat Restoration - Acquire a conservation easement on approximately 11,000 acres in Sutter County and Sacramento County in a 1-mile wide band along the Sacramento River from Sankey Road to near the mouth of the American River. These lands would be managed to optimize habitat for the Swainson's hawk. Agricultural crops that are of value for foraging would be retained. Other crops may need to be converted into higher wildlife value foraging crops.

Small Waterways/Buffers/Giant Garter Snake - There are numerous waterways within the Natomas Area that are of high value to the giant garter snake and other wildlife species. These areas should be protected with 100-foot-wide buffer zones on each side. These zones would be managed to continue prescribed water conveyance, improve garter snake habitat and restore wetland riparian corridors.

Large Waterway Riparian Corridors/Fisheries Restoration - There are at least four major waterways that have high potential for riparian corridor restoration and fisheries habitat improvement in the project area. These include the Natomas Cross Canal, Natomas East Main Drainage Canal, Dry Creek, and Arcade Creek. Of these, the Natomas East Main Drainage Canal has the highest potential for restoration due to its severely degraded condition. Revegetation, channel clean up and contouring, fencing, instream structure placement, better water supply and other measures could greatly improve values in the Drainage Canal. Similar work on the other waterways would also produce high benefits.

The foregoing proposal calls for 7,600 acres of agricultural land in Sutter County and 18,000 acres of agricultural land in Sacramento County to be placed in some form of fish and wildlife management. Most of these lands lie west of State Route 70/99. Portions of agriculture crops of value to wildlife would remain in production, but other crops of low value would gradually be phased out and converted for wildlife purposes.

In order to insure that lands are administered in perpetuity for fish and wildlife purposes a resource agency such as the Fish and Wildlife Service, California Department of Fish and Game, Nature Conservancy or similar agency should be responsible for managing the plan. Other cooperators should assist in developing the plan and monitoring its success.

We believe this proposal offers excellent opportunities to (1) avoid a substantial portion of the impacts of the project, thereby significantly reducing the mitigation need; (2) meet the

President's goal of no overall net loss of wetlands; (3) be consistent with Executive Orders 11990 (Protection of Wetlands) and 11988 (Floodplain Management); (4) provide full flood protection to the Natomas Area; (5) provide open space and recreational opportunities in the Natomas Area; (6) preserve valuable agricultural lands; (7) protect wintering habitat of migratory waterfowl and other water-associated birds of the Pacific Flyway, birds protected under the Migratory Bird Treaty Act; (8) be consistent with the Cooperative Agreement, pursuant to the North American Waterfowl Management Plan, between the Department of the Interior and Department of the Army regarding waterfowl habitat conservation opportunities associated with Corps of Engineers civil works projects; and (9) develop the Natomas Area (by the city and county of Sacramento and Sutter County) in a manner that would balance the needs of fish and wildlife and other uses.

Primary responsibility for developing the plan should be with the California Central Valley Habitat Joint Venture. Cooperators in plan development would include the Corps of Engineers, Fish and Wildlife Service, California Department of Fish and Game, city of Sacramento, Sacramento County, Sutter County, and Reclamation District 1000. Funding should be provided by the Corps of Engineers via the umbrella of the Cooperative Agreement between the Department of the Interior and the Department of the Army in support of the North American Waterfowl Management Plan. Additional funding should be provided from the California Central Valley Habitat Joint Venture commensurate with their acreage goals in the American Basin. Easement and fee title lands acquired with the plan should be managed by one or more resource agencies or resouce entities.

Once a detailed plan is developed, another Habitat Evaluation Procedures analysis would be required to reasses project mitigation needs. Land acquisition, and assurances to manage mitigation, and other areas as specified in the detailed plan, should be provided for in the authorizing document.

RECOMMENDATIONS

For the 200-Year Protection Alternative, we recommend that:

1. Fish protective measures be included to reduce salmon and steelhead losses at the gated structure and pump station in the Natomas East Main Drainage Canal. Measures include fish screens, other fish protection facilities, and limiting in-channel construction activity to the June 1 to August 31 period. The design and costs have not been determined at this time. Protective fish screen design and other measures should be coordinated with the Fish and Wildlife Service and California Department of Fish and Game.

2. An area totaling 17,650 acres in the Natomas Area be acquired, developed and managed as a wetland/upland complex to offset the loss of 787 acres of wetlands and 21,930 acres of upland habitat. Development cost would be about $171,675,000, excluding land acquisition and water supply for wetland management. Cost of fencing the wetland/upland complex is estimated at $200,000. Annual cost of replacement, operation and maintenance of the complex is estimated at $8,825,000.

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APPENDIX A

ENDANGERED SPECIES

United States Department of the Interior

FISH AND WILDLIFE SERVICE
SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

AUG 0 4 1987

In Reply Refer To:
JW/1-1-87-SP-508

Mr. Walter Yep
Chief, Planning Division
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

Subject: List of Endangered and Threatened Species in the American River Watershed

Dear Mr. Yep:

As requested by letter from your agency dated July 2, 1987, you will find attached a list of listed endangered and threatened species (Attachment A) that may be present in the area of the subject project. To the best of our knowledge no proposed species occur within the area. The list is intended to fulfill the requirement of the Fish and Wildlife Service to provide a list of species under Section 7(c) of the Endangered Species Act, as amended. Please see Attachment B for your requirements.

Also for your assistance, we have included a list of candidate species. These species are presently being reviewed by our Service for consideration to propose and list as endangered or threatened. Candidate species have no protection under the Endangered Species Act and are included for your consideration as it is possible the candidates could become formal proposals and be listed during the construction period.

Upon completion of the Biological Assessment (see Attachment B), should you determine that a listed species is likely to be affected (adversely or beneficially), then your agency should request formal Section 7 consultation through our office at the letterhead address. If there are both listed and candidate species (if included in the assessment) that may be affected and if requested, we will informally consult on the candidate species during the formal consultation. However,

FISH AND WILDLIFE SERVICE
RECEIVED
AUG 04 1987
SACRAMENTO
DIVISION OF ECOLOGICAL SERVICES

should the assessment reveal that only candidate species may be affected, then you should consider informal consultation with our office at the letterhead address.

One of the benefits of informal consultation to the consulting agency is to provide the necessary planning alternatives should a candidate species become listed before completion of a project. Informal consultation may also be utilized prior to a written request for formal consultation to exchange information and resolve conflicts with respect to listed species.

If the Biological Assessment is not initiated within 90 days of receipt of this letter, you should informally verify the accuracy of the list with our office.

Should you have any additional questions regarding this list or your responsibilities under the Act, please contact Dr. Jack Williams at (916) 978-4866 or (FTS) 460-4866. Thank you for your interest in endangered species, and we await your assessment.

Sincerely,

Jack E. Williams

For Gail C. Kobetich
Field Supervisor

Attachments

cc: Chief, Endangered Species, Portland, Oregon (FWE-SE; Attn: Ralph Swanson)
Field Supervisor, Ecological Services, Sacramento, California (ES-S)

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE AMERICAN RIVER WATERSHED, CALIFORNIA
(Case No. 1-1-87-SP-508)

Listed Species

Birds

Bald eagle, *Haliaeetus leucocephalus* (E)
(nests at Union Valley Reservoir and winters at other reservoirs)

Insects

Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)
(occurs along the American River below Folsom)

Plants

Truckee barberry, *Berberis sonnei* (E)

Proposed Species

None

Candidate Species

Birds

Swainson's hawk, *Buteo swainsoni* (2)
(also state-listed as threatened)

Reptiles

Giant garter snake, *Thamnophis couchi gigas* (2)
(also state-listed as threatened)

Plants

Pleasant Valley mariposa, *Calochortus clavatus* var. *avius* (1)
Stebbins' morning-glory, *Calystegia stebbinsii* (2)
hispid bird's-beak, *Cordylanthus mollis* subsp. *hispidus* (2)
Cup Lake draba, *Draba asterophora* var. *macrocarpa* (2)
El Dorado bedstraw, *Galium californicum* subsp. *sierrae* (2)
Boggs Lake hedge-hyssop, *Gratiola heterosepala* (2)
legenere, *Legenere limosa* (2)
saw-toothed lewisia, *Lewisia serrata* (2)
Stebbins' phacelia, *Phacelia stebbinsii* (2)
bearded allocarya, *Plagiobothrys hystriculus* (2)
valley sagittaria, *Sagittaria sanfordii* (2)
El Dorado mule-ears, *Wyethia reticulata* (2)

(E)--Endangered (T)--Threatened (CH)--Critical Habitat

(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

APPENDIX B

COOPERATIVE AGREEMENT

COOPERATIVE AGREEMENT
BETWEEN THE DEPARTMENT OF THE INTERIOR
AND
DEPARTMENT OF THE ARMY
REGARDING WATERFOWL HABITAT CONSERVATION OPPORTUNITIES
ASSOCIATED WITH
CORPS OF ENGINEERS CIVIL WORKS PROJECTS AND ACTIVITIES
CONSISTENT WITH THE NORTH AMERICAN WATERFOWL MANAGEMENT PLAN

WHEREAS: The Department of the Interior is the primary Federal agency charged with fish and wildlife resource protection and restoration, including the protection and wise use of wetlands, especially those having greatest importance for migratory birds, threatened and endangered species, and anadromous fishes.

WHEREAS: The Department of the Interior is the United States signatory to the North American Waterfowl Management Plan and is the lead U. S. Federal Agency for implementation of the plan, which is one important component of the Department's wetland protection and restoration effort.

WHEREAS: The Department of the Army through its Civil Works legislative authorities, has broad water resources development responsibilities and authorities, and through operation of such water resources projects has stewardship responsibilities for over seven million acres of water and land.

NOW THEREFORE: The Department of the Interior and the Department of the Army have agreed to enter into a cooperative agreement to further the goals of the North American Waterfowl Management Plan of May 14, 1986.

I. PURPOSE:

To provide a plan of coordination and cooperation between the DOI and DA for the conservation, development and management of habitat for waterfowl and associated wetland species on Army civil works projects, in response to goals set forth in the joint United States and Canadian North American Waterfowl Management Plan.

II. **AUTHORITY:**

This Agreement conforms with the Memoranda of Agreement (August 20, 1954 and September 21, 1980) between the Department of the Interior and the Department of the Army for carrying out fish and wildlife conservation and management activities set forth in the Fish and Wildlife Coordination Act of 1946 (60 Stat. 1080) and the Fish and Wildlife Coordination Act of 1958 (16 U.S.C 661-666), as amended; the Forest Cover Act of 1960 (66 U.S.C. 580m-580n); the Federal Water Project Recreation Act of 1965, as amended, (16 U.S.C. 460-1(12), et seq); Section 150 of the Water Resources Development Act of 1976 (PL 94-587); and, Section 906(e), et al, of the Water Resources Development Act of 1986 (PL 99-662).

III. **DISCUSSION:**

On May 14, 1986, the U.S. Secretary of the Interior and the Canadian Minister of the Environment signed the North American Waterfowl Management Plan. The Plan recognizes the value of North America's waterfowl and provides a blueprint for restoring waterfowl populations on the North American continent. The Plan places emphasis on protection and improvement of waterfowl habitat in the two countries and identifies 34 major habitat areas involving approximately six million acres. It also focuses on a goal to ensure habitat for 62 million breeding ducks on the continent and a fall flight in excess of 100 million birds. This goal is based on the amount of habitat present during 1970-1979.

Both the Canadian and U.S. wildlife services realize they cannot accomplish Plan goals alone. Timely and effective coordination and cooperation between the public and private sectors are required. In the Plan, this coordination and cooperation process is identified as the "Joint Venture" approach. It provides the framework of a Federal, State, private partnership to implement a combination of wetland habitat protection, restoration, and development actions designed and managed to benefit breeding, migrating, and wintering waterfowl. It is in this spirit of cooperation that the Department of the Interior and Department of the Army agree to participate in a coordinated effort to address Plan goals. The Army will participate in the NAWMP by identifying the extent to which Corps of Engineers civil works projects address Plan goals; by identifying other opportunities at operating projects to address Plan goals; and by identifying and evaluating

opportunities for restoring and developing waterfowl habitats during the planning, design and construction of new Corps projects.

IV. RESPONSIBILITIES AND PROCEDURES:

A. The Fish and Wildlife Service of the Department of the Interior will:

1. Initiate coordination with appropriate Corps offices and provide full details on Regional and National Plan goals and the location and status of current and proposed joint venture activities within the boundary of each Corps district.

2. Advise Corps districts of Federal and non-Federal joint venture proponents.

3. Provide consultation, at its own expense, in Corps approved planning for and implementation of activities to improve waterfowl habitat on operating Corps projects.

B. The Corps of Engineers of the Department of the Army will:

1. Provide appropriate FWS field offices and joint venture partners with a list of Army civil works projects, operated and managed by the Corps, in major habitat and joint venture areas identified by FWS.

2. For these projects, provide FWS with:

a. A description of current waterfowl-oriented management activities being carried out by the Corps;

b. Available maps and other material showing the extent and location of resource areas frequented by waterfowl on project lands; and

c. Information on waterfowl management on lands licensed to States under Section 663(b) of the FWCA.

3. Identify, in coordination with FWS, waterfowl habitat improvement opportunities for Corps projects, and describe generally the types of actions required to accomplish identified opportunities.

4. Consistent with the FWCA, invite FWS into early stages of planning for new projects to avoid or minimize adverse impacts to waterfowl habitat, and to identify opportunities for contributing to the NAWMP goals.

C. The FWS and Corps will jointly:

1. Determine how technical expertise within each agency may be shared in addressing NAWMP goals.

2. a. For projects identified under B1 above, coordinate with States during scheduled reviews of General Plans and related licenses to determine if such documents address Plan goals and address the national migratory bird management program set forth in the Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 663(b), and recommend changes considered appropriate.

b. Describe how and to what extent waterfowl habitat conservation and development opportunities, identified under B.2. above, would address regional and national Plan goals.

3. Consider Plan goals during the planning, engineering and design, and construction phases of Corps projects within high priority, joint-venture areas.

4. Share with others in the Joint Venture Group the materials developed for planning purposes from these efforts including material resulting from B2.

V. COMMITMENTS IN FUNDING:

This agreement does not commit nor obligate funds, equipment, or personnel from either agency. All activities under this Agreement will be undertaken subject to availability of funds.

VI. AGENCY POINTS OF CONTACT (POCs) AND REPORTING:

Within 90 days of the effective date of this Agreement, the signature parties will identify agency POCs, who will recommend internal and joint reporting and coordination procedures under this Agreement.

VII. EFFECTIVE DATE AND DURATION:

This Agreement is effective immediately upon the last signature date below and will continue in effect for three calendar years, or until modified or revoked by agreement of

both parties, or revoked by either party alone upon 30 days written notice. Modifications to this document may be made by mutual agreement and such modifications will be in effect upon signature of the modified document.

Becky Norton Dunlop	for John S Doyle Jr. DEPUTY
Assistant Secretary of the Interior for Fish and Wildlife and Parks	Assistant Secretary of the Army (Civil Works)
January 23, 1989	JANUARY 10, 1989
Date	Date

APPENDIX C

LIST OF PLANTS AND ANIMALS

Appendix C

Fishes of the Lower Sacramento River

Common Name	Scientific Name
Anadromous Game Fish	
Chinook salmon	Salmo gairdneri gairdneri
Steelhead	Oncorhynchus kisutch
Silver salmon	Oncorhynchus gorbuscha
Pink Salmon	Oncorhynchus keta
White sturgeon	Acipenser transmontanus
Warmwater Game Fish	
*Spotted bass	Micropterus punctualatus
*Largemouth bass	Micropterus salmoides
*Smallmouth bass	Micropterus dolomieui
*Warmouth bass	Lepomis gulosus
*Green sunfish	Lepomis cyanellus
*Bluegill	Lepomis machrochirus
*Redear sunfish	Lepomis microlophus
*White crappie	Pomoxis annularis
Sacramento perch	Archoplites interruptus
*Channel catfish	Ictalurus punctatus
*White catfish	Ictalurus catus
*Brown bullhead	Ictalurus nubulosus
*Black bullhead	Ictalurus melas
Nongame Fish	
Sacramento western sucker	Catostomus occidentalis
*Carp	Cyprinus carpio
*Goldfish	Carassius auratus
Sacramento blackfish	Orthodon microlepidotus
Hardhead	Mylopharodon conocephalus
Sacramento hitch	Lavinia exilicauda
Sacramento squawfish	Ptychocheilus grandis
Sacramento Splittail	Pogonichthys macrolepidotus[2]
*Mosquitofish	Gambusia affinis
Tule perch	Hysterocarpus traski
Riffle sculpin	Cottus gulosus
Pacific lamprey	Entosphenus tridentatus
*Threadfin shad	Dorosoma petenense
*Golden shiner	Notemigonus crysoleucas
*Fathead minnow	Pimephales promelas
Western roach	Hesperoleucas symmetricus
Sacramento tui chub	Gila bicolor
Speckled dace	Rhinichthys osculus sp.
*Log perch	Percina macrolepida

Source: Modified from Gerstung 1971.
Note: · * Introduced species
[1] Possibly extirpated
[2] Federal candidate, Category 2.

The Scientific and Common Names of Plant Species Discussed in the Text

Common Names	Scientific Names	Area of Occurrence[1] Nat.	L. Am.	Aub.
Alkali bulrush	Scirpus olneyi	X	X	
Alkali heath	Frankenia grandiflora var. campestris	X		
Alkali weed	Cressa truxellensis	X	X	
Asparagus	Asparagus sp.	X	X	X
Baltic rush	Juncus balticus	X	X	X
Bigleaf maple	Acer macrophyllum		X	X
Blackberry	Rubus procerus	X	X	X
Black oak	Quercus kelloggii			X
Black sage	Salvia mellifera		X	X
Bladderwort	Utricularia sp.	X	X	X
Blue oak	Quercus douglasii	X	X	X
Blue wild rye	Elymus glaucus	X	X	X
Boisduvalia	Boisduvalia sp.	X	X	
Boxelder	Acer negundo ssp. californicum	X	X	X
Brome	Bromus sp.	X	X	X
Brass buttons	Cotula coronopifolia	X	X	
Brodiaea	Brodiaea Dichelostemma and Triteleia sp.	X	X	X
Buckbrush	Ceanothus cuneatus		X	X
Buckeye	Aesculus californica		X	X
Buckwheat	Eriogonum sp.	X	X	X
Bulrush	Scirpus acutus	X	X	X
Burrow bush	Hymenochlea salsola	X	X	
Busk monkeyflower	Diplacus aurantiacus		X	X
Buttonwillow	Cephalanthus occidentalis	X	X	X
California bay	Umbellularia californica		X	X
California melic	Melica californica	X	X	X
California sagebrush	Artemisia californica	X	X	X
Canyon live oak	Quercus chrysolepis	X	X	X
Cat's ear	Hypochoeris glabra	X	X	X
Cattails	Typha latifolia and T. angustifolia	X	X	X
Chain fern	Woodwardia fimbriata		X	X
Chamise	Adenostoma fasciculatum			X
Clematis	Clematis sp.	X	X	X
Clover	Trifolium sp.	X	X	X
Cocklebur	Xanthium strumarium var. canadense	X	X	X
Coffeeberry	Rhamnus californicus ssp. tomentella	X	X	X

[1] Nat. = Natomas, L. Am = Lower American, Aub. = Auburn

(cont.)

		Area of Occurrence Nat.	L. Am	Aub.
Common reed grass	*Phragmites communis*	X	X	
Cottonwood	*Populus fremontii*	X	X	X
Creek dogwood	*Cornus stolonifera*		X	X
Digger pine	*Pinus sabiniana*		X	X
Douglas-fir	*Pseudotsuga menziesii*			X
Downingia	*Downingia* sp.	X	X	
Duckweed	*Lemna minor*	X	X	X
Elderberry	*Sambucus* spp.	X	X	X
Elodea	*Elodea canadensis*	X	X	X
Fat hen	*Atriplex patula*	X	X	X
Fescue	*Festuca* spp.	X	X	X
Fiddleneck	*Amsinckia* spp.	X	X	X
Filaree	*Erodium* spp.	X	X	X
Flannel bush	*Fremontodendron californicum*			X
Fleshy jaumea	*Jaumea carnosa*	X	X	
Flowering dogwood	*Cornus nuttallii*			X
Foxtail	*Hordeum* spp.	X	X	X
Giant reed	*Arundo donax*	X	X	
Goldfields	*Lasthenia californica*	X	X	
Gooseberry	*Ribes* sp.		X	X
Hairgrass	*Deschampsia danthonioides*	X	X	X
Hazelnut	*Corylus cornuta* var. *californica*			X
Horned pondweed	*Zanichellia palustris*	X	X	
Horsetail	*Equisetum* spp.	X	X	X
Horseweed	*Conyza canadensis*	X	X	X
Incense cedar	*Calocedrus decurrens*			X
Interior live oak	*Quercus wislizenii*		X	X
Iodine bush	*Allenrolfea occidentalis*	X		
Knit grass	*Gastridium ventricosum*	X	X	X
Lady fern	*Athyrium filix-femina*		X	X
Barley	*Hordeum* spp.	X	X	X
Lupine	*Lupinus* spp.	X	X	X
Manzanita	*Arctostaphylos* spp.		X	X
Grindelia	*Grindelia* spp.	X	X	X
Marsh pennywort	*Hydrocotyle verticillata*	X	X	
Meadowfoam	*Limnanthes* sp.	X	X	X
Mistletoe	*Phoradendron* sp.	X	X	X
Mountain mahogany	*Cercocarpus betuloides*		X	X
Mousetail	*Myosurus minimus*	X		
Mugwort	*Artemisia douglasiana*	X	X	X
Mulefat	*Baccharis viminea*	X	X	X
Mustard	*Brassica*	X	X	X
Navarretia	*Navarretia* sp.	X	X	X
Nettles	*Urtica* sp.	X	X	X
Needlegrass	*Stipa* spp.	X	X	X
Oregon ash	*Fraxinus latifolia*	X	X	X
Owl's clover	*Orthocarpus* spp.	X	X	X
Pepper grass	*Lepidium* sp.	X	X	X
Pickleweed	*Salicornia* sp.	X		

(cont.)

		Area of Occurrence		
		Nat.	L. Am	Aub.
Pogogyne	*Pogogyne douglasii*	X	X	
Poison-oak	*Toxicodendron diversilobum*	X	X	
Ponderosa pine	*Pinus ponderosa*			X
Pondweed	*Potamogeton* sp.	X	X	X
Popcorn flower	*Plagiobothrys* sp.	X	X	X
Poppy	*Eschscholzia californica*	X	X	X
Redbud	*Cercis occidentalis*		X	X
Rush	*Juncus* sp.	X	X	X
Salt grass	*Distichlis spicata*	X	X	
Sand-spurry	*Spergularia* sp.	X	X	
Sedge	*Carex* sp.	X	X	X
Seep-weed	*Suaeda* spp.	X		
Serviceberry	*Amelanchier* sp.			X
Snowberry	*Symphoricarpos* sp.			X
Spice bush	*Calycanthus occidentalis*			X
Spike rush	*Eleocharis macrostachya*	X	X	X
Saltbush	*Atriplex* spp.	X	X	X
Sugar pine	*Pinus lambertiana*			X
Sycamore	*Platanus racemosa*	X	X	X
Tanoak	*Lithocarpus densiflora*			X
Thistle	*Silybum marianum*	X	X	X
Toyon	*Heteromeles arbutifolia*		X	X
Tule	*Scirpus* sp.	X	X	X
Umbrella sedge	*Cyperus eragrostis*	X	X	X
Valley oak	*Quercus lobata*	X	X	X
Valley saltbush	*Atriplex polycarpa*	X	X	
Verbena	*Verbena* spp.	X	X	
Walnut	*Juglans* spp.	X	X	
Water fern	*Azolla filiculoides*	X	X	X
Water lily	*Nuphar polysepalum*	X	X	X
Water milfoil	*Myriophyllum* sp.	X	X	X
White alder	*Alnus rhombifolia*	X	X	X
White fir	*Abies concolor*			X
White thorn	*Ceanothus cordulatus*			X
Wild grape	*Vitis californica*	X	X	X
Wild oats	*Avena* spp.	X	X	X
Wild rose	*Rosa californica*	X	X	X
Willow	*Salix* sp.	X	X	X
Woolly marbles	*Psilocarphus brevissimus*	X	X	
Yellow waterweed	*Ludwigia peploides*	X	X	

Table A. Wildlife Species of the American River Watershed Study Area

Common Name	Scientific Name	Habitats[a]
	BIRDS	
Red-throated loon	Gavia stellata	O
Common loon	Gavia immer	O
Pied-billed grebe	Podilymbus podiceps	O,M
Horned grebe	Podiceps auritus	O,M
Eared grebe	Podiceps nigricollis	O,M
Western grebe	Aechmophorus occidentalis	O
American white pelican	Pelecanus erythrorhynchos	O,M
Double-crested cormorant	Phalacrocorax auritus	O,M
American bittern	Botaurus lentiginosus	M
Great blue heron	Ardea herodias	M,R
Great egret	Casmerodius albus	M,R
Snowy egret	Egretta thula	M
Cattle egret	Bubulcus ibis	M,A
Green-backed heron	Butorides striatus	M,R
Black-crowned night heron	Nycticorax nycticorax	M,R
White-faced ibis	Plegadis chihi	M,A
Tundra swan	Cygnus columbianus	M,A
Greater white-fronted goose	Anser albifrons	M,A
Snow goose	Chen caerulescens	M,A
Ross' goose	Chen rossii	M,A
Canada goose	Branta canadensis	M,A,C
Wood duck	Aix sponsa	M,R
Green-winged teal	Anas crecca	M,O
Mallard	Anas platyrhynchos	M,O
Norther Pintail	Anas acuta	M,O
Blue-winged teal	Anas discors	M,O
Cinnamon teal	Anas cyanoptera	M,O
Northern shoveler	Anas clypeata	M,O
Gadwall	Anas strepera	M,O
Eurasian wigeon	Anas penelope	M,O
American wigeon	Anas americana	M,O
Canvasback	Aythya valisineria	M,O
Redhead	Aythya americana	M,O
Ring-necked duck	Aythya collaris	M,O
Greater scaup	Aythya marila	M,O
Lesser scaup	Aythya affinis	M,O
Common goldeneye	Bucephala clangula	M,O
Barrow's goldeneye	Bucephala islandica	M,O
Bufflehead	Bucephala albeola	M,O
Hooded merganser	Lophodytes cucullatus	M,O
Common merganser	Mergus merganser	O
Ruddy duck	Oxyura jamaicensis	M,O

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Turkey vulture	*Cathartes aura*	C,W,A,F
Osprey	*Pandion haliaetus*	O
Black-shouldered kite	*Elanus caeruleus*	C,W,A
Bald eagle	*Haliaeetus leucocephalus*	O
Northern harrier	*Circus cyaneus*	A,G,M
Sharp-shinned hawk	*Accipiter striatus*	W,G,R,F
Cooper's hawk	*Accipiter cooperii*	W,G,R,F
Northern goshawk	*Accipiter gentilis*	W,G,F
Red-shouldered hawk	*Buteo lineatus*	R
Swainson's hawk	*Buteo swainsoni*	A,R,G
Red-tailed hawk	*Buteo jamaicensis*	A,R,G,W,C,F
Ferruginous hawk	*Buteo regalis*	A,G
Rough-legged hawk	*Buteo lagopus*	A,G
Golden eagle	*Aquila chrysaetos*	G,W
American kestrel	*Falco sparverius*	A,G,R,F
Merlin	*Falco columbarius*	A,G
Peregrine falcon	*Falco peregrinus*	M,A,G,F
Prairie falcon	*Falco mexicanus*	G,A,M
Ring-necked pheasant	*Phasianus colchicus*	A,R
Wild turkey	*Meleagris gallopavo*	G,W,F
California quail	*Callipepla californica*	O,W,C,R,F
Mountain quail	*Oreortyx pictus*	W,C,F
Virginia rail	*Rallus limicola*	M
Sora	*Porzana carolina*	M
Common moorhen	*Gallinula chloropus*	M,O
American coot	*Fulica americana*	M,O
Sandhill crane	*Grus canadensis*	A,M
Black-bellied plover	*Pluvialis squatarola*	G,M,A
Lesser golden plover	*Pluvialis dominica*	G,M,A
Snowy plover	*Charadrius alexandrinus*	M
Semipalmated plover	*Charadrius semipalmatus*	M
Killdeer	*Charadrius vociferus*	M,A,G
Mountain plover	*Charadrius montanus*	A
Black-necked stilt	*Himantopus mexicanus*	M,A
American avocet	*Recurvirostra americana*	M,A
Greater yellowlegs	*Tringa melanoleuca*	M
Lesser yellowlegs	*Tringa flavipes*	M
Solitary sandpiper	*Tringa solitaria*	M
Willet	*Catoptrophorus semipalmatus*	M
Spotted sandpiper	*Actitis macularia*	M,R
Whimbrel	*Numenius phaeopus*	M
Long-billed curlew	*Numenius americanus*	M,A,C

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[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Marbled godwit	*Limosa fedoa*	M
Red Knot	*Calidris canutus*	M
Western sandpiper	*Calidris mauri*	M
Least sandpiper	*Calidris minutilla*	M
Baird's sandpiper	*Calidris bairdii*	M
Pectoral sandpiper	*Calidris melanotos*	M
Dunlin	*Calidris alpina*	M
Short-billed dowitcher	*Limnodromus griseus*	M
Long-billed dowitcher	*Limnodromus scolopaceus*	M
Common snipe	*Gallinago gallinago*	M
Wilson's phalarope	*Phalaropus tricolor*	M,O
Red-necked phalarope	*Phalaropus lobatus*	M,O
Bonaparte's gull	*Larus philadelphia*	M,O
Mew gull	*Larus canus*	M,O
Ring-billed gull	*Larus delawarensis*	M,O,A
California gull	*Larus californicus*	M,O,A
Herring gull	*Larus argentatus*	M,O,A
Thayer's gull	*Larus thayeri*	M,O,A
Glaucous-winged gull	*Larus glaucescens*	M,O,A
Caspian tern	*Sterna caspia*	O
Forster's tern	*Sterna forsteri*	O
Black tern	*Chlidonias niger*	M,O
Rock dove	*Columba livia*	G,A
Band-tailed pigeon	*Columba fasciata*	W,C,F
Mourning dove	*Zenaida macroura*	A,W,C,G,F
Yellow-billed cuckoo	*Coccyzus americanus*	R
Greater roadrunner	*Geococcyx californianus*	C
Common barn-owl	*Tyto alba*	A,G
Western screech-owl	*Otus kennicottii*	W,R,F
Great horned owl	*Bubo virginianus*	W,R,F
Northern pygmy-owl	*Glaucidium gnoma*	W
Burrowing owl	*Athene cunicularia*	G,A
Long-eared owl	*Asio otus*	R
Short-eared owl	*Asio flammeus*	O,A,M
Northern saw-whet owl	*Aegolius acadicus*	W,F
California spotted owl	*Strix occidentalis*	W,F
Lesser nighthawk	*Chordeiles acutipennis*	C,R,F
Common nighthawk	*Chordeiles minor*	C,R,F
Common poorwill	*Phalaenoptilus nuttallii*	C,R
Vaux's swift	*Chaetura vauxi*	R,C,F
White-throated swift	*Aeronautes saxatalis*	R,C,W,F
Black-chinned hummingbird	*Archilochus alexandri*	R,C
Anna's hummingbird	*Calypte anna*	R,C,U,F

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[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Costa's hummingbird	*Calypte costae*	R,C
Rufous hummingbird	*Selasphorus rufus*	R,U
Allen's hummingbird	*Selasphorus sasin*	R,U
Belted kingfisher	*Ceryle alcyon*	R,O
Lewis' woodpecker	*Melanerpes lewis*	W,G,F
Acorn woodpecker	*Melanerpes formicivorous*	W,G,F
Yellow-bellied sapsucker	*Sphyrapicus varius*	W,R,A
Red-breasted sapsucker	*Sphyrapicus ruber*	W,R,F
Nuttall's woodpecker	*Picoides nuttallii*	W,R,F
Downy woodpecker	*Picoides pubescens*	W,R,F
Hairy woodpecker	*Picoides villosus*	W,F
Northern flicker	*Colaptes auratus*	W,R,G,F
Olive-sided flycatcher	*Contopus borealis*	W,R,F
Western wood-pewee	*Contopus sordidulus*	W,R,F
Willow flycatcher	*Empidonax traillii*	R
Hammond's flycatcher	*Empidonax hammondii*	R,W,F
Dusky flycatcher	*Empidonax oberholseri*	R,W,C,F
Gray flycatcher	*Empidonax wrightii*	R
Western flycatcher	*Empidonax difficilis*	R,F
Black phoebe	*Sayornis nigricans*	R,M
Say's phoebe	*Sayornis saya*	G
Ash-throated flycatcher	*Myiarchus cinerascens*	W,R
Western kingbird	*Tyrannus verticalis*	G
Horned lark	*Eremophila alpestris*	G
Purple martin	*Progne subis*	G
Tree swallow	*Tachycineta bicolor*	R,A,G,F
Violet-green swallow	*Tachycineta thalassina*	R,A,G,F
Northern rough-winged swallow	*Stelgidopteryx serripennis*	R,A,G
Bank swallow	*Riparia riparia*	R
Cliff swallow	*Hirundo pyrrhonota*	R,A,G,O
Barn swallow	*Hirundo rustica*	R,A,G,O
Scrub jay	*Aphelocoma coerulescens*	W,R,F
Yellow-billed magpie	*Pica nuttalli*	G,R
American crow	*Corvus brachyrhynchos*	W,G,R
Plain titmouse	*Parus inornatus*	W,R,F
Bushtit	*Psaltriparus minimus*	W,R,F
Red-breasted nuthatch	*Sitta canadensis*	W,F
White-breasted nuthatch	*Sitta carolinensis*	W,F
Brown creeper	*Certhia americana*	W,F
Rock wren	*Salpinctes obsoletus*	Ro
Canyon wren	*Catherpes mexicanus*	Ro
Bewick's wren	*Thryomanes bewickii*	R,W,C,F

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[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
House wren	Troglodytes aedon	R,W,F
Winter wren	Troglodytes troglodytes	R
Marsh wren	Cistothorus palustris	M
American dipper	Cinclus mexicanus	R
Golden-crowned kinglet	Regulus satrapa	W,R,F
Ruby-crowned kinglet	Regulus calendula	W,R,F
Blue-gray gnatcatcher	Polioptila caerulea	R,C,F
Western bluebird	Sialia mexicana	G,W,C
Mountain bluebird	Sialia currucoides	G,W
Townsend's solitaire	Myadestes townsendi	W,F
Swainson's thrush	Catharus ustulatus	R,W,F
Hermit thrush	Catharus guttatus	R,W,C,F
American robin	Turdus migratorius	G,R,W,C,U,F
Varied thrush	Ixoreus naevius	R,W,F
Wrentit	Chamaea fasciata	R,C
Northern mockingbird	Mimus polyglottos	R,C,U
California thrasher	Toxostoma redivivum	C,R
Water pipit	Anthus spinoletta	G
Cedar waxwing	Bombycilla cedrorum	W,F
Phainopepla	Phainopepla nitens	R,W,F
Loggerhead shrike	Lanius ludovicianus	G,A
European starling	Sturnus vulgaris	G,A,U,W,C
Solitary vireo	Vireo solitarius	W,R,F
Hutton's vireo	Vireo huttoni	W,R,F
Warbling vireo	Vireo gilvus	W,R,F
Orange-crowned warbler	Vermivora celata	C,R,W,F
Nashville warbler	Vermivora ruficapilla	R,W,F
Yellow warbler	Dendroica petechia	R,F
Yellow-rumped warbler	Dendroica coronata	R,W,U,F
Black-throated gray warbler	Dendroica nigrescens	W,F
Townsend's warbler	Dendroica townsendi	W,F
Hermit warbler	Dendroica occidentalis	W,F
MacGillivray's warbler	Oporornis tolmiei	W,R,F
Common yellowthroat	Geothlypis trichas	M,R
Wilson's warbler	Wilsonia pusilla	M,R,C,F
Yellow-breasted chat	Icteria virens	R
Western tanager	Piranga ludoviciana	W,R,F
Black-headed grosbeak	Pheucticus melanocephalus	W,R
Blue grosbeak	Guiraca caerulea	R,G
Lazuli bunting	Passerina amoena	R,G,W,F
Rufous-sided towhee	Pipilo erythrophthalmus	C,U,F
Brown towhee	Pipilo fuscus	C,U,F
Rufous-crowned sparrow	Aimophila ruficeps	C,R
Chipping sparrow	Spizella passerina	C,R,W,F

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[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Vesper sparrow	*Pooecetes gramineus*	G
Lark sparrow	*Chondestes grammacus*	G,W
Sage sparrow	*Amphispiza belli*	C
Savannah sparrow	*Passerculus sandwichensis*	G,R
Fox sparrow	*Passerella iliaca*	R,C,F
Song sparrow	*Melospiza melodia*	R,M
Lincoln's sparrow	*Melospiza lincolnii*	R,M
Golden-crowned sparrow	*Zonotrichia atricapilla*	G,U,C
White-crowned sparrow	*Zonotrichia leucophrys*	G,U,C
Dark-eyed junco	*Junco hyemalis*	G,W,C,F
Red-winged blackbird	*Agelaius phoeniceus*	M,R,G,A
Tricolored blackbird	*Agelaius tricolor*	M,R,G,A
Western Meadowlark	*Sturnella neglecta*	G,F
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	M
Brewer's blackbird	*Euphagus cyanocephalus*	M,A,U,G
Brown-headed cowbird	*Molothrus ater*	R,M,G,A
Northern oriole	*Icterus galbula*	W,F
Purple finch	*Carpodacus purpureus*	R,W,F
House finch	*Carpodacus mexicanus*	R,W,A,U,F
Pine siskin	*Carduelis pinus*	W,F
Lesser goldfinch	*Carduelis psaltria*	R,G,W,F
Lawrence's goldfinch	*Carduelis lawrencei*	R,G,W,C,F
American goldfinch	*Carduelis tristis*	R,G,W,C,F
Evening grosbeak	*Coccothraustes vespertinus*	W,F
House sparrow	*Passer domesticus*	U
	AMPHIBIANS	
Foothill Yellow legged frog	*Rana boylei*	R,M,F
California newt	*Taricha torosa*	R,G,W,F
Tiger salamander	*Ambystoma tigrinum*	R,G
California slender salamander	*Batrachoseps attenuatus*	R,G,W
Arboreal salamander	*Aneides lugubris*	W
Western spadefoot	*Scaphiopus hammondi*	G
Western toad	*Bufo boreas*	R,G
Pacific treefrog	*Hyla regilla*	R,G
Bullfrog	*Rana catesbeiana*	M
Ensatina	*Ensatina eschschottzi*	R,W,M,F

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[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	REPTILES	
Western pond turtle	<u>Clemmys marmorata</u>	M,R,F
Western fence lizard	<u>Sceloporus occidentalis</u>	C,W,G,F
Gilbert's skink	<u>Eumeres gilberti</u>	G,W,Ro
Western skink	<u>Eumeres skiltonianus</u>	G,W,Ro
Western whiptail	<u>Cnemidophorus tigris</u>	W,R
Southern alligator lizard	<u>Gerrhonotus multicarinatus</u>	G,C,W,F
Ringneck snake	<u>Diadophis punctatus</u>	W,G,C,F
Sharp-tailed snake	<u>Contia tenuis</u>	W,G,C,F
Coachwhip	<u>Masticophis flagellum</u>	G,W
Racer	<u>Coluber constrictor</u>	C,G,F
Gopher snake	<u>Pituophis melaneoleucus</u>	G,W,R,M,A,F
Common kingsnake	<u>Lampropeltis getulus</u>	G,W,R,M,F
Long-nosed snake	<u>Rhinocheilus lecontei</u>	G,W
Giant garter snake	<u>Thamnophis gigas</u>	M,R,O,~~F~~
Common garter snake	<u>Thamnophis sirtalis</u>	A,M,G
Western terrestrial garter snake	<u>Thamnophis elegans</u>	M,G,F
Western aquatic garter snake	<u>Thamnophis couchi</u>	M,G,O,F
Night snake	<u>Hypsiglena torquata</u>	C,R
Western rattlesnake	<u>Crotalus virdis</u>	C,G,R,W,F
Coast horned lizard	<u>Phrynosoma coronatum</u>	G,Ro,W,C,A
	MAMMALS	
Trowbridge shrew	<u>Sorex trowbridgei</u>	R,W
Virginia opossum	<u>Didelphis virginiana</u>	R,F
Vagrant shrew	<u>Sorex vagrans</u>	R,G,M
Ornate shrew	<u>Sorex ornatus</u>	R,M
California myotis	<u>Myotis californicus</u>	Widespread in many habitat
Red bat	<u>Lasiurus borealis</u>	Widespread in many habitat
Hoary bat	<u>Lasiurus cinereus</u>	Widespread in many habitat
Pallid bat	<u>Antrozous pallidus</u>	Widespread in many habitat
Brazilian free-tailed bat	<u>Tadarida brasiliensis</u>	Widespread in many habitat
Big free-tailed bat	<u>Tadarida macrotis</u>	Widespread in many habitat
Desert cottontail	<u>Sylvilagus audubonii</u>	G,M,R
Brush rabbit	<u>Sylvilagus bachmani</u>	C,W,R
Broad-footed mole	<u>Scapanus latimanus</u>	G,W,A
Yuma myotis	<u>Myotis yumanensis</u>	Widespread in many habitat
Western pipistrelle	<u>Pipistrellus hesperus</u>	Widespread in many habitat
Big Brown Bat	<u>Eptesicus fuscus</u>	Widespread in many habitat
Townsends big-caved bat	<u>Plecotus townsendi</u>	Widespread in many habitat

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[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	MAMMALS	
Black-tailed hare	Lepus californicus	G,M
California ground squirrel	Spermophilus beecheyi	G,M,R,C
Beaver	Castor canadensis	R,M,F
Western harvest mouse	Reithrodontomys megalotis	G
Deer mouse	Peromyscus maniculatus	G,F
California vole	Microtus californicus	G,F
Muskrat	Ondatra zibethicus	M,F
Black rat	Rattus rattus	U,A,F
Norway rat	Rattus norvegicus	U,A,F
House mouse	Mus musculus	U,A,F
Coyote	Canis latrans	C,W,G,F
Red fox	Vulpes vulpes	G,W,F
Gray fox	Urocyon cinereoargenteus	G,W,R,F
Ringtail	Bassariscus astutus	R,F
Raccoon	Procyon lotor	R,F
Mink	Mustela vison	R,M,F
Western spotted skunk	Spilogale gracilis	R
Striped skunk	Mephitis mephitis	R,W
River otter	Lutra canadensis	R
Black-tailed deer	Odocoileus hemionus	C,W,G,R,F
Western gray squirrel	Sciurus griseus	W,R,F
Botta's pocket gopher	Thomomy's bottae	R,G,W
Brush mouse	Peromyscus boylei	C,W,F
Pinyon mouse	Peromyscus truei	W,Ro,F
Dusky-footed woodrat	Neotoma fuscipes	C,W,R,F
Porcupine	Erethizon dorsatum	C,F
Long-tailed weasel	Mustela frenata	Widespread in many habitat
Badger	Taxidea taxus	G,A,W
Mountain lion	Felis concolor	R,W,C,Ro,F
Bob cat	Lynx rufus	R,G,W,C,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

APPENDIX D

INVENTORY OF HEAVILY SHADED RIVERINE AQUATIC COVER

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Division of Ecological Services
2800 Cottage Way, Room E-1803
Sacramento, California 95825

INVENTORY OF

HEAVILY-SHADED RIVERINE AQUATIC COVER

FOR THE LOWER SACRAMENTO RIVER

AND SACRAMENTO-SAN JOAQUIN DELTA

PART III: SACRAMENTO RIVER, AMERICAN RIVER

TO NATOMAS CROSS CANAL

by
Richard W. DeHaven
and
Gary L. Taylor
Fish and Wildlife Biologists

Prepared partially for
U.S. Army Corps of Engineers, Sacramento District
American River Watershed Study

October 1988

ABSTRACT

Heavily-Shaded Riverine Aquatic ~~(HSRA)~~ Cover occurs where riparian vegetation overhangs and protrudes into a moving, channelized body of water. Because of its limited distribution and high values for fish and wildlife, the Fish and Wildlife Service has been inventorying HSRA Cover. Two inventories have been completed. This is a report of the third inventory for the reach of the Sacramento River from River Mile 60.2 (American River confluence) to 78.9 (Natomas Cross Canal confluence). HSRA Cover was mapped while traveling slowly along the river by motorboat. Of 197,472 linear feet of nearshore aquatic area available along the 18.7-mile reach, about 43,000 feet (22 percent) had true HSRA Cover. As in previous inventories, HSRA Cover was "clumped" rather than uniformly distributed. Only 1 of 42 mappable occurrences of HSRA Cover had High overall values for fish and wildlife; the other 41 occurrences were classified as either Good (26 percent) or Better (71 percent) in fish and wildlife values. Most of the HSRA Cover had reduced values for fish and wildlife because of annual levee maintenance operations, chiefly the burning of vegetation.

INTRODUCTION

Where riparian vegetation overhangs and protrudes into a stream or river channel, a unique, nearshore aquatic zone may develop. The primary characteristic of this aquatic zone is the shade it receives (from the overhanging vegetation) during a major part of each daylight cycle. Other important attributes of the shaded aquatic area, one or more of which are usually present, include: (1) living roots, branches, and tree trunks exposed within the water; (2) fallen plant material, including logs, branches, and leaves within the water; (3) relatively irregular and uneven natural banks, often with many depressions, cavities, and crevices; (4) comparatively shallow, low-velocity areas near the shoreline; (5) more detritus and greater primary food-chain production than nearby unshaded areas; and (6) lower water temperatures than comparable unshaded nearshore areas.

Various names have been used to describe such unique, nearshore aquatic areas. Recently, the Sacramento Ecological Services Field Office of the U.S. Fish and Wildlife Service (Service), has been referring to such aquatic areas as Heavily-Shaded Riverine Aquatic (HSRA) Cover.

Because of its many unique attributes, HSRA Cover is highly valuable to fish and wildlife. Unfortunately, the extent of HSRA Cover has been severely reduced throughout much of California. Some of the greatest losses of HSRA Cover have occurred in the lower Sacramento River basin and Sacramento-San Joaquin Delta, mainly as a result of bank protection

(riprapping) efforts. Several new proposed flood control and water resource development projects could cause further degradation and losses of HSRA Cover.

To prevent further losses of this important resource, the Service has been assisting agency planners by inventorying HSRA Cover. The inventories show the locations, amounts, and relative value to fish and wildlife of remaining HSRA Cover along selected riverine channels. The first report, completed in March 1988, covered the lower Sacramento River (American River confluence downstream to the southwestern tip of Grand Island) and its primary distributaries. A second report in April 1988 inventoried the channels surrounding 23 selected islands of the Sacramento-San Joaquin Delta. The present inventory reported here is for the lower middle Sacramento River, from the Natomas Cross Canal (River Mile 78.9) downstream to the confluence with the American River (River Mile 60.2).

The present inventory was partially funded by the U.S. Army Corps of Engineers, Sacramento District, under its American River Watershed Study.

INVENTORY AND EVALUATION PROCEDURES

Field Evaluations

The surveyed reach of the Sacramento River is 18.7 miles in length. The survey was conducted on September 23 and 28, 1988.

HSRA Cover was mapped while traveling slowly along the river by motorboat. One person operated the boat, while a second person mapped all HSRA Cover which was continuous for at least 100 feet along the bank. It was previously determined that only a small (< 5 percent) amount of the total remaining HSRA cover occurs in strips less than 100 feet in length. Field mapping data were recorded on blue-lined copies of 1986 aerial photographs (scale 1:4,800) provided by the Corps.

Each occurrence of HSRA Cover was identified by River Mile (using the Corps' designations) and bank orientation (i.e., left or right bank, looking downstream): waterside length of each site was later measured from the field maps using an electronic planimeter. The average width of the riparian plant canopy overhanging and shading the water (with sun at mid-day) was determined from three to ten visual estimates of width made at random locations along the length of each site. The acreage of each site was later estimated from the product of the measured length and the estimated average width.

In the field, three other variables were recorded to assist in comparing the overall relative value of each occurrence of HSRA cover to fish and wildlife resources. The three variables were: (1) whether the site was true HSRA Cover, with natural banks, or a modified type of HSRA Cover, with riprapped banks; (2) the overall percent canopy cover over the water, based on a rating of either low (≤ 25 percent), moderate (26-75 percent), or high (> 75 percent); and (3) the overall density of in-water cover (tree roots,

branches, logs and other plant material as well as cavities, depressions, and other cover within the natural banks themselves, if present) based on a rating of either low ($\leq$10 percent), moderate (11-50 percent), or high (>50 percent).

Relative Site Values

The overall value to fish and wildlife of each occurrence of HSRA Cover was based on a total rating score. The total rating score was the sum of the individual scores for the following five criteria: (1) length of site; (2) width of site; (3) percent canopy cover of site; (4) percent in-water cover of site; and (5) type of bank present. A fixed scoring system (Appendix 1) was used for rating each of the five criteria. From the total rating score, the overall value of each HSRA site to fish and wildlife was broadly categorized as follows: total rating score of 5-9 = Good; 10-17 = Better; and 18-25 = Highest value to fish and wildlife.

RESULTS AND DISCUSSION

This 18.7-mile reach of the Sacramento River had 197,472 linear feet of nearshore aquatic area available for HSRA cover. Of this total, about 43,000 feet (22 percent) had true HSRA Cover and another 941 feet had riprapped HSRA Cover.

The location and characteristics of each of the 42 occurrences of HSRA

Cover are given in Table 1. Length of the sites ranged from 100 to 6,800 feet. Width of the sites ranged from 1 to 7 feet, but 31 (74 percent) were $\leq$ 3-feet-wide.

The HSRA Cover was unevenly distributed along the river. For example, from about River Mile 65 to 69, HSRA Cover was only found along the left bank, while from about River Mile 75 to 79, HSRA Cover only occurred on the right bank. However, this "clumping" of HSRA Cover was not as pronouced as in the two previous inventories done along the lower Sacramento River (and distributaries) and Delta islands.

Also, in the previous inventories, it was found that most of the HSRA Cover had less than maximum possible values for fish and wildlife. A minor problem is the gradual loss of some streamside riparian areas (with their accompanying shade and in-water cover) along the river due to erosion. A much greater limiting factor, however, is the widespread levee maintenance operations, especially burning and spraying of vegetation with herbicides, which is reducing the maximum density and width of vegetation over and within the water. Without these disturbances, much of the overhanging vegetation would probably develop a high percentage of canopy cover, with shade provided over 20 feet or more of the water at mid-day. Presently, most of the HSRA Cover is less than 4-feet-wide, and a large amount (60 percent of the sites) is 2 feet or less in width.

Only two HSRA sites had both high canopy cover and high aquatic cover density. One of the sites, at about River Mile 65.0 (left bank), was only

116-feet-long and 3-feet-wide. The other site, which extended from about River Mile 78.6 to 78.7 (right bank), was 645 feet in length and 6 feet in width.

Overall values to fish and wildlife were rated as Good at 11 (26 percent) of the HSRA sites, Better at 30 (71 percent) of the sites, and Highest at only 1 (2 percent) site. The site which received the Highest rating extended from about River Mile 78.1 to 78.6 right (bank). The Highest rating was mainly due to the length (2,560 feet) of the site; the width was only about 3 feet, with moderate canopy and moderate in-water cover.

Two additional occurrences of HSRA cover (not included in Table 1) were found off the main channel of the river. One of the these sites was about 460 x 3-feet in size (with moderate canopy cover and moderate in-water cover); it was located along a backwater area just off the main river channel near River Mile 68.8 (right bank). The other non-riverine HSRA Cover comprised about 1,100 x 1-feet of area (with moderate canopy cover and low in-water cover) along an overflow basin just off the main river channel near River Mile 69.5 (right bank).

Table 1. Heavily-Shaded Riverine Aquatic Cover remaining along the Sacramento River, American River mouth (River Mile 60.2) to Natomas Cross Canal (River Mile 78.9), on September 23, 1988.

Site Number	River Mile (Approximate)	Bank[a]	Length (ft)	Width (ft)	Area (ac)	Canopy Cover[b]	Aquatic Cover Density[c]	Bank Type[d]	Overall Habitat Value[e]
1	60.5-61.8	R	6,800	2	.3	L	L	N	B
2	64.7	L	175	6	<.1	M	M	N	B
3	65.0	L	116	3	<.1	H	H	N	B
4	65.2	L	135	4	<.1	M	H	N	B
5	65.5	L	250	5	<.1	M	M	N	B
6	66.1	L	160	4	<.1	M	L	N/R	G
7	66.8	L	275	2	<.1	L	L	N	G
8	67.2-67.6	L	2,000	2	.1	L	L	N	B
9	67.9-68.1	L	935	1	<.1	L	L	N	G
10	68.3	L	200	3	<.1	M	M	N	B
11	68.4-68.5	L	975	3	.1	M	L	N	B
12	68.5-68.6	L	720	2	<.1	M	L	N	B
13	68.7	L	100	4	<.1	H	M	N	B
14	68.8-69.0	R	865	1	<.1	L	H	N	B
15	69.5-69.6	R	750	1	<.1	L	L	N	G
16	69.5-69.8	L	1,880	2	.1	L	L	N	B
17	69.9	R	350	2	<.1	M	M	N	G
18	69.9-70.0	L	580	2	<.1	L	L	N	G
19	70.8-70.9	L	750	2	<.1	L	L	N	G
20	70.8	R	115	3	<.1	H	M	N	B
21	70.9	R	110	2	<.1	L	L	N	G
22	71.0-71.6	L	2,980	1	.1	L	L	N/R	B
23	72.4-72.5	R	555	5	.1	M	H	N	B
24	72.8	R	430	2	<.1	M	M	N	G
25	72.9	L	130	6	<.1	H	M	N/R	B
26	72.9	L	160	7	<.1	H	M	N	B
27	73.3	L	125	6	<.1	H	M	N	B
28	73.3-73.4	R	740	2	<.1	L	M	N	B
29	73.5-74.1	R	2,650	1	.1	L	L	N	B
30	73.5-74.3	L	3,700	1	.1	L	L	N	B
31	74.4-74.5	L	635	2	<.1	M	L	N	B
32	74.7	L	120	1	<.1	M	L	N	G
33	74.8	L	100	5	<.1	M	M	N	B
34	75.2-76.2	L	5,190	1	.1	L	L	N	B
35	75.4-75.5	R	635	1	<.1	L	L	N	G
36	76.0-76.2	R	1,120	1	<.1	L	L	N	B
37	76.6-76.9	R	1,575	2	.1	M	H	N	B
38	77.2-77.3	R	1,100	1	<.1	L	L	N	B
39	77.5	R	285	1	<.1	M	H	N	B
40	78.0	R	265	3	<.1	M	M	N	B
41	78.1-78.6	R	2,560	3	.2	M	M	N	H
42	78.6-78.7	R	645	6	.4	H	H	N	B

a/ R = Right Bank; L = Left Bank (Proceeding Downstream).
b/ L = Low ($\leq$ 25%); M = Moderate (26-75%); H = High (>75%).
c/ L = Low ($\leq$ 10%); M = Moderate (11-50%); H = High (>50%).
d/ N = Natural Banks; R = Riprapped Banks.
e/ G = Good overall value for fish and wildlife; B = Better overall value; H = Highest overall value. See text for description of rating system.

Appendix 1. Rating system for determing the relative overall value to fish and wildlife of each HSRA cover site.

1. Length of site (ft)	Rating Score
100- 500	2
501-1,000	4
1,001-1,500	6
1,501-2,000	8
2,001-2,500	10
>2,500	12

2. Width of site (ft)	Rating Score
1-2	0
3-4	1
5-6	2
7-8	3
>9	4

3. Percent Canopy Cover	Rating Score
≤25	1
26-75	2
>75	3

4. Percent Aquatic Cover	Rating Score
≤10	1
11-50	2
>50	3

5. Type of Bank	Rating Score
Riprapped	1
Natural	3

For each HSRA cover site, the rating score for all five criteria were summed to derive the total rating score.

APPENDIX E

DEPARTMENT OF FISH AND GAME

MID-WINTER WATERFOWL SURVEY

1980-1990

Mid-Winter Central Valley Waterfowl Surveys - California Department of Fish and Game

	Mallard	Pintail	Widgeon	Shoveler	Green Winged Teal	Cinnamon Teal	Gadwall	Ruddy Duck	Redhead	Canvas-Back	Ring Necked	Scaup	Bufflehead	Goldeneye	Swans	Dark Geese	Light Goose	Canada Goose	Coots
1990 Verona	1003	2216	1500	20	50		20								210	2500			
Sutter Bypass		215	20				10								50				
1989 N. Natomas	2500	9000													1900	1600	800	300	
Sutter Bypass	500	3500													50		1200	75	
1988 Yolo Bypass	6700	33500	3100	2200	1200			1000							2750	5095	4000	500	4000
1987 Yolo Bypass	15600	32500	1300	5500	8600		20	550					35		4225	1750	600	275	
1986 Yolo Bypass	3600	25400	1350	2025				610		55			30		1495	7100	5000	675	
1985 Yolo Bypass	1050	5275	805		395			600							4965	2700	3600	625	
1984 Yolo Bypass	36000	136,400	9050	2200	1300		200	8900	200	10800	315	565			7775	1240	45	20	
1983 Yolo Bypass	3002	167,999		1	199	2		3474		225		57	41		1637				
1982 Lincoln and Natomas	220	18936	10							500		10			833				

Mid-Winter Central Valley Waterfowl Surveys - California Department of Fish and Game

	Mallard	Pintail	Widgeon	Shoveler	Green Winged Teal	Cinnamon Teal	Gadwall	Ruddy Duck	Redhead	Canvas-Back	Ring Necked	Scaup	Bufflehead	Goldeneye	Swans	Dark Geese	Light Goose	Canada Goose	Coots
1981																			
Natomas	1020	34,435	775	10	350										18			10	600
Sutter Bypass	722	1,160	215														25		775
Yolo Bypass	880	18,835	210	775	1060			6450		350					770			75	5600
1980																			
Natomas	75	235								25					80	35	125		400
Yolo Bypass	9525	93,500	7650	2150				450		350	550			100	1545	650			

Yolo Bypass includes the area by I-80 to the South, the west levee of Yolo Bypass Fremont Weir to the north, and the Sacramento River to the north and east. Also included are the Woodland Sewer Ponds and the Cache Creek Settling Basin. Total acreage: 22,750

The boundaries for Natomas and Verona are not clearly defined, nor were those areas surveyed consistently.

File:

November 2, 1990

Caroline Wilkinson
U.S. Fish & Wildlife Service
2800 Cottage Way
Room E-1803
Sacramento, CA 95825

Dear Ms. Wilkinson:

Here are the data you requested on waterfowl numbers for the northwestern portion of Sacramento County. This information was collected over the years by volunteer observers of the Sacramento Audubon Society.

The Christmas Bird Count results are for areas 1 and 2 of the Sacramento Count circle (see map attached). Christmas Bird Counts, as you probably know, are one-day counts conducted in the latter half of December. I've included data for grebes, cormorants, and ardeids as well, in case it may be of some use.

I've also included preliminary data (the project is not yet complete) on the breeding distribution of five species (American Bittern, Snowy Egret, Black-crowned Night-Heron, Mallard, and Cinnamon Teal) in Sacramento County. These data are being compiled for the Sacramento County Breeding Bird Atlas Project. Of interest in these data is the fact that at least four of these species (data for the bittern, a secretive species, are fragmentary) reach their highest densities (yet reported) in the northwestern corner of the county. In other words, the rice fields and other wetland habitats in this area are some of the most valuable waterbird nurseries in the county.

I hope this information is of some help to you. Please let me know if you have any questions or if I can be of further assistance.

Sincerely,

Tim Manolis

Tim Manolis
Chairman, Research Committee
Sacramento Audubon Society

APPENDIX F

SACRAMENTO AUDUBON

CHRISTMAS COUNT

SURVEY DATA 1980-1990

SACRAMENTO CHRISTMAS BIRD COUNT RESULTS -- Area 1 -- 19[illegible] and 1979-[illegible]

FIRST_NAME	LAST_NAME	A0189	A0188	A0187	A0186	A0185	A0184	A0183	A0182	A0181	A0180	A0179	[illegible]	[illegible]
PIED-BILLED	GREBE	15	7	2	18	18	10	17	30	7	6	12	[illegible]	5
EARED	GREBE	0	0	0	0	0	0	2	0	0	0	[illegible]	[illegible]	
DOUBLE-CRESTED	CORMORANT	1	0	0	2	2	0	0	1	1	0	[illegible]	[illegible]	
AMERICAN	BITTERN	1	0	1	[illegible]	0	2	2	0	[illegible]	[illegible]	5	[illegible]	[illegible]
GREAT BLUE	HERON	15	18	17	22	19	8	22	30	27	25	[illegible]	[illegible]	
GREAT	EGRET	38	72	86	57	59	36	47	111	105	120	75	[illegible]	5
SNOWY	EGRET	0	7	0	0	0	7	0	0	[illegible]	1	[illegible]	[illegible]	[illegible]
CATTLE	EGRET	0	6	2	[illegible]	0	0	75	0	7	0	5	[illegible]	
GREEN-BACKED	HERON	[illegible]	0	0	2	[illegible]	1	[illegible]	[illegible]	[illegible]	6	1	[illegible]	15
BLACK-CROWNED	NIGHT-HERON	110	101	57	91	251	220	375	251	[illegible]	[illegible]	115	[illegible]	5
TUNDRA (WHISTLING)	SWAN	6	714	1062	43	525	200	8	70	46	115	[illegible]	[illegible]	[illegible]
GREATER WHITE-FRONTED	GOOSE	[illegible]	127	0	10	10	10	50	35	37	[illegible]	[illegible]	[illegible]	[illegible]
SNOW	GOOSE	[illegible]	[illegible]	774	140	330	60	38	325	1456	[illegible]	[illegible]	[illegible]	[illegible]
ROSS	GOOSE	0	[illegible]	0	0	[illegible]	0	0	2	[illegible]	[illegible]	[illegible]		
CANADA	GOOSE	16	125	0	0	145	0	15	165	26	[illegible]	[illegible]	[illegible]	[illegible]
CANADA	GOOSE (LARGE)	0	[illegible]	119	0	[illegible]	0	0	0	[illegible]	0	[illegible]	[illegible]	
CANADA	GOOSE (SMALL)	0	0	1	0	0	0	0	0	[illegible]	0			
WOOD	DUCK	0	[illegible]	0	16	[illegible]	2	9	2	2	0	[illegible]	[illegible]	[illegible]
GREEN-WINGED	TEAL	[illegible]	0	0	0	0	0	0	0	0	[illegible]	[illegible]	15	[illegible]
	MALLARD	12	48	39	23	48	12	0	27	53	16	51	28	[illegible]
NORTHERN	PINTAIL	0	50	52	424	77	1	1	120	35	1	72	540	[illegible]
NORTHERN	SHOVELER	8	2	15	11	0	0	0	0	0	1	0	0	[illegible]
AMERICAN	WIGEON	1	[illegible]	[illegible]	[illegible]	16	0	0	0	0	2	10	[illegible]	
	CANVASBACK	0	6	5	5	0	2	0	0	0	0	0	0	[illegible]
	REDHEAD	0	[illegible]	0	0	[illegible]	0	0	0	0	0	0	0	[illegible]
RING-NECKED	DUCK	0	0	0	1	1	0	1	0	0	0	0	[illegible]	[illegible]
LESSER	SCAUP	0	2	26	0	[illegible]	0	0	0	0	[illegible]	0	[illegible]	[illegible]
COMMON	GOLDENEYE	0	5	18	0	1	2	0	0	[illegible]	0	[illegible]	0	[illegible]
	BUFFLEHEAD	0	0	6	0	0	0	1	0	0	0	0		
RUDDY	DUCK	15	30	177	21	37	14	1	0	0	0	[illegible]		
	DUCK SP?	0	0	0	0	0	0	2	0	0	0	15		[illegible]

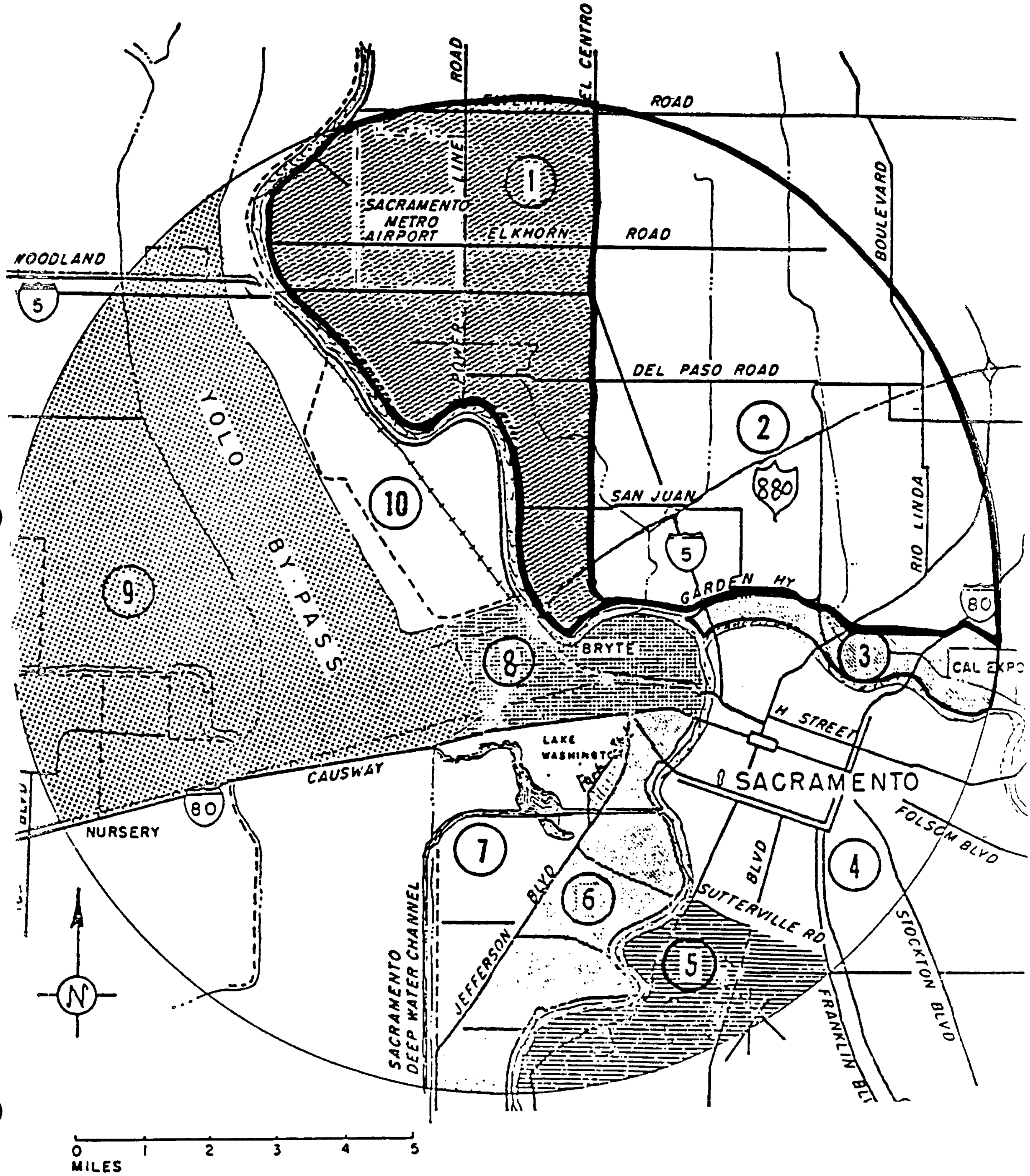
About the column heads: A0189 = results for 1989; A0188 = results for 1988; etc.

Best Available Copy

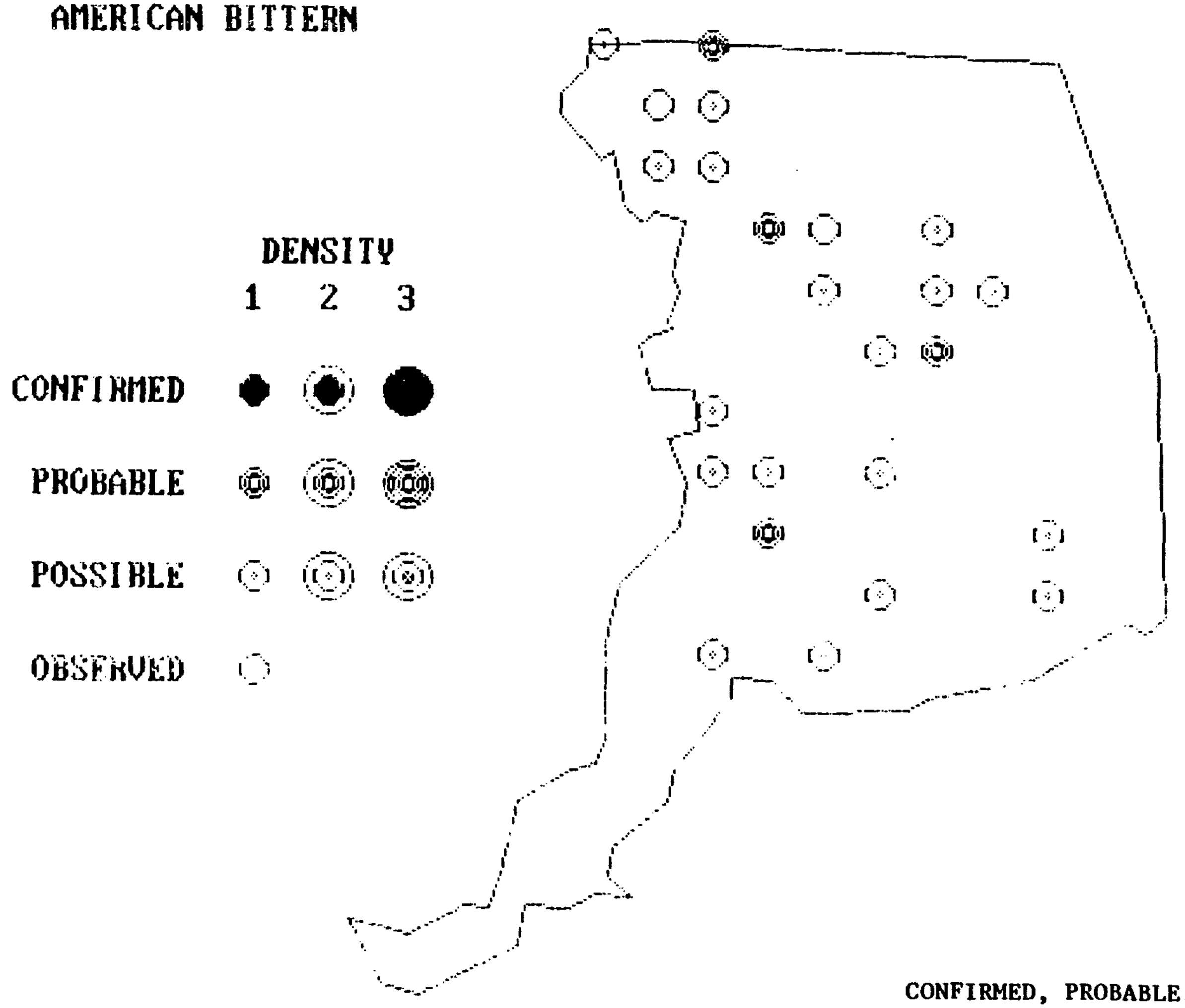
SACRAMENTO CHRISTMAS BIRD COUNT RESULTS -- Area 2 -- 1976-77 and 1979-89

FIRST_NAME	LAST_NAME	A0289	A0288	A0287	A0286	A0285	A0284	A0283	A0282	A0281	A0280	A0279	A0277	A0276
PIED-BILLED	GREBE	25	45	26	20	9	7	3	25	52	33	30	19	15
EARED	GREBE	0	0	0	0	0	0	0	0	0	2	1	0	[illegible]
DOUBLE-CRESTED	CORMORANT	0	0	0	5	0	0	0	0	0	0	0	[illegible]	[illegible]
AMERICAN	BITTERN	1	3	0	1	1	1	1	2	14	10	0	6	11
GREAT BLUE	HERON	18	18	14	23	3	9	9	27	28	36	8	7	[illegible]
GREAT	EGRET	39	30	79	37	35	20	38	65	59	68	56	15	
SNOWY	EGRET	0	0	0	2	0	1	0	0	2	0	0	0	[illegible]
GREEN-BACKED	HERON	0	1	0	1	1	0	0	5	8	3	2	1	[illegible]
BLACK-CROWNED	NIGHT-HERON	29	185	69	17	0	63	23	10	6	1	0	0	[illegible]
TUNDRA (WHISTLING)	SWAN	7	15	123	9	191	4	0	22	8	0	0	20	[illegible]
GREATER WHITE-FRONTED	GOOSE	0	0	0	0	35	0	0	0	0	0	9	0	[illegible]
SNOW	GOOSE	0	0	9	0	172	0	0	0	0	0	0	125	[illegible]
CANADA	GOOSE	0	152	0	1	37	1	0	21	0	5	17	[illegible]	[illegible]
WOOD	DUCK	0	4	1	47	7	0	2	0	[illegible]	2	[illegible]	[illegible]	[illegible]
GREEN-WINGED	TEAL	0	0	2	0	0	0	0	2	0	0	0	[illegible]	[illegible]
	MALLARD	77	52	85	32	18	1	2	61	27	4	18	14	[illegible]
NORTHERN	PINTAIL	0	0	2	65	29	9	0	0	12	0	4	455	[illegible]
CINNAMON	TEAL	0	0	1	0	0	0	1	0	0	0	0	4	
NORTHERN	SHOVELER	1	0	3	0	3	0	0	0	0	0	0	30	[illegible]
	GADWALL	1	0	0	0	0	0	0	0	0	0	0	[illegible]	[illegible]
AMERICAN	WIGEON	1	1	7	0	2	0	1	1	0	0	0	[illegible]	[illegible]
	CANVASBACK	0	0	0	0	0	0	0	0	5	8	7	6	[illegible]
LESSER	SCAUP	0	[illegible]	4	0	0	0	0	0	0	1	0	[illegible]	[illegible]
	SCAUP (SP?)	0	0	0	0	0	0	0	0	0	0	0	3	[illegible]
COMMON	GOLDENEYE	0	5	0	2	0	0	10	9	0	1	0	0	[illegible]
BARROW'S	GOLDENEYE	0	1	0	2	2	0	1	0	0	0	0	0	[illegible]
	BUFFLEHEAD	0	1	3	0	2	0	2	0	0	0	0	0	[illegible]
COMMON	MERGANSER	0	1	0	0	0	0	0	0	0	0	[illegible]	0	[illegible]
RUDDY	DUCK	3	15	11	0	2	0	0	235	175	120	75	[illegible]	[illegible]

CHRISTMAS BIRD COUNT AREA
of the
SACRAMENTO AUDUBON SOCIETY

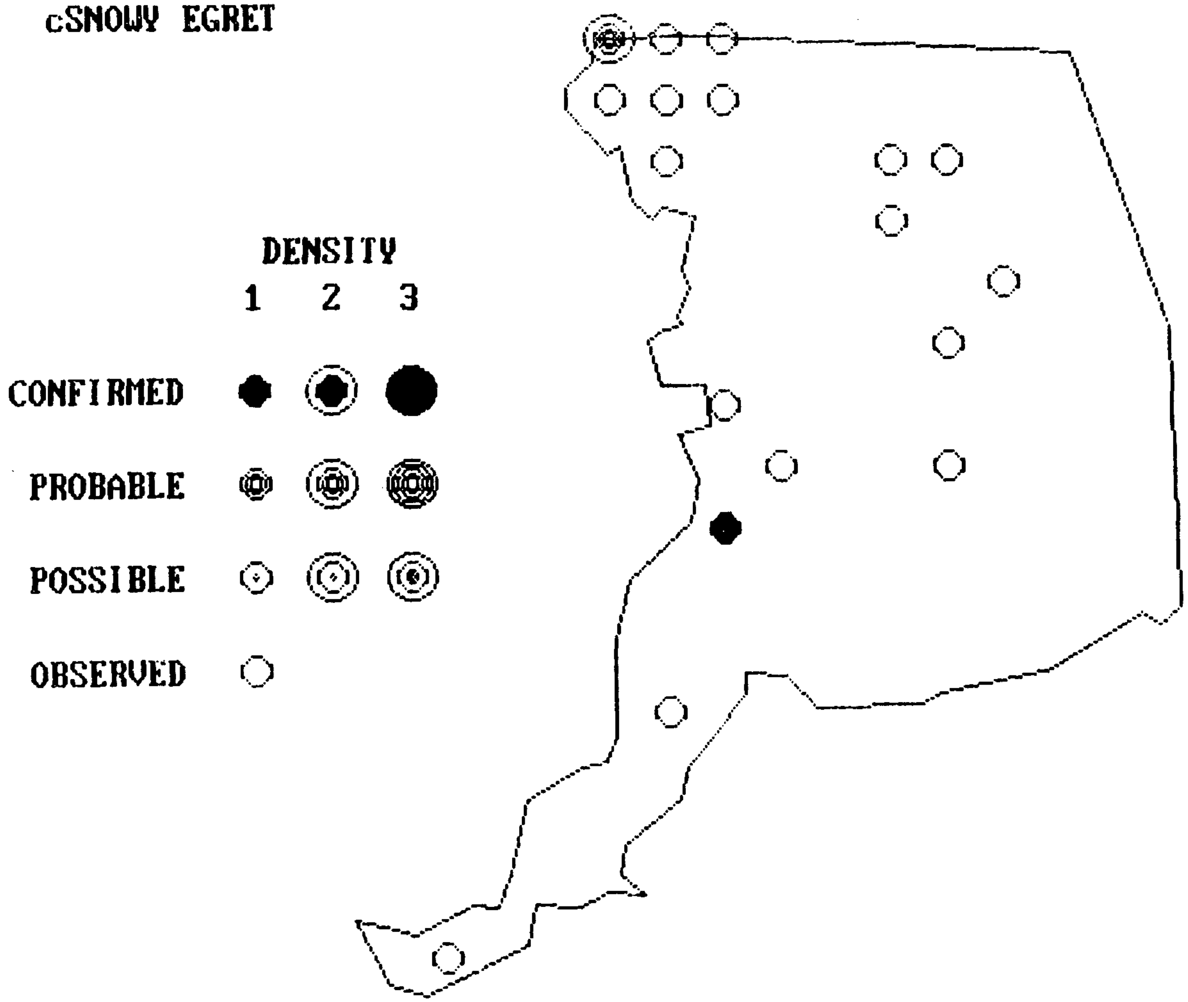


AMERICAN BITTERN

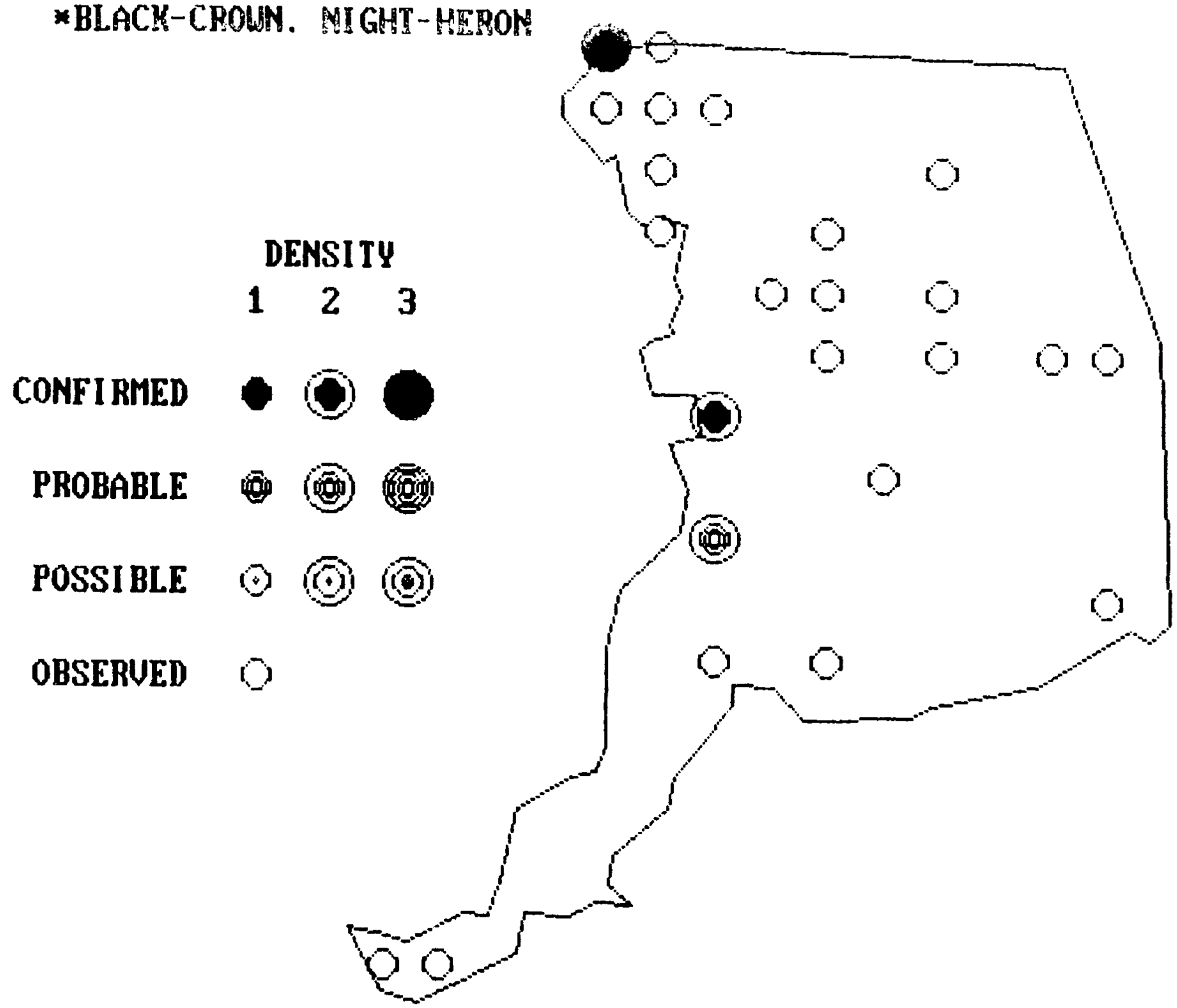


CONFIRMED, PROBABLE, and POSSIBLE refer to categories of breeding status determined by the level of breeding evidence obtained by the volunteer observer assigned to each atlas block. Density categories (based on estimates made by the observers) are: 1 = 1-9 breeding pairs; 2 = 10-99 breeding pairs; 3 = 100 or more breeding pairs.

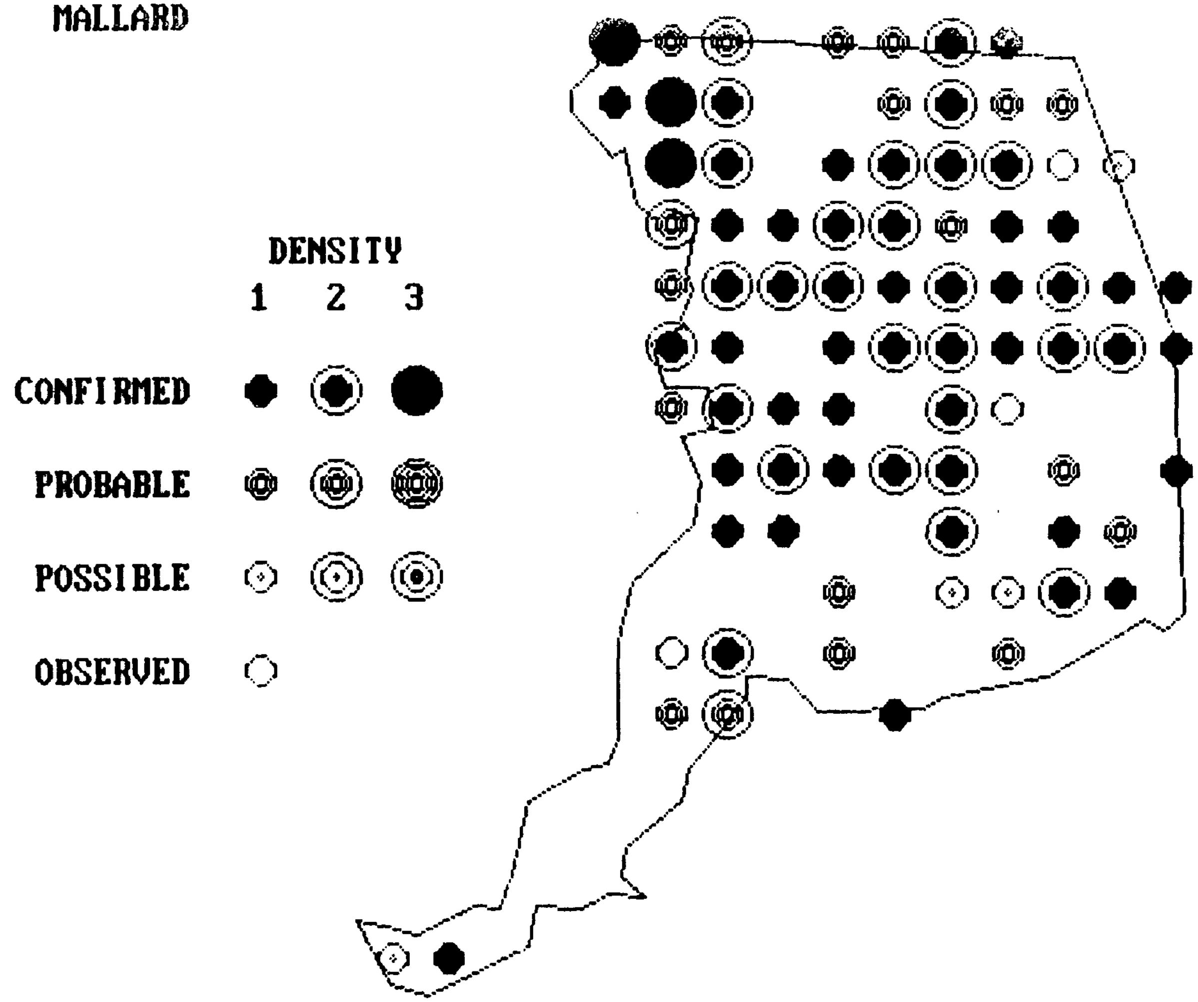
cSNOWY EGRET



*BLACK-CROWN. NIGHT-HERON



MALLARD



CINNAMON TEAL

DENSITY

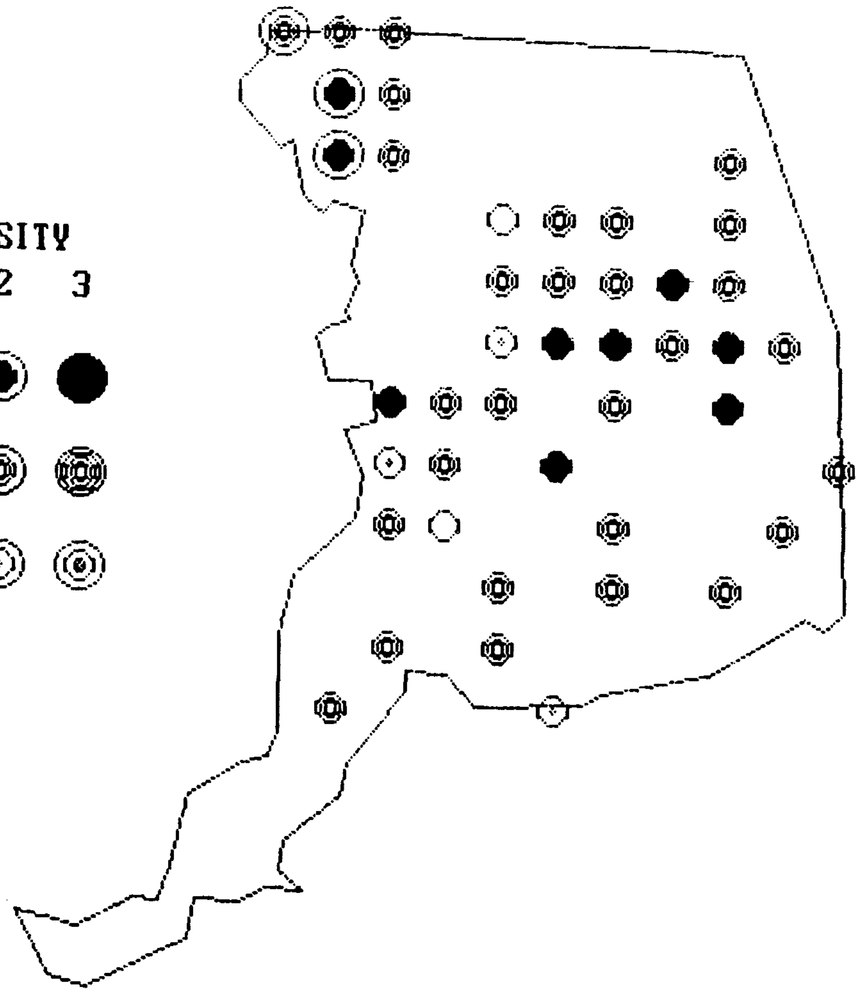
1 2 3

CONFIRMED

PROBABLE

POSSIBLE

OBSERVED



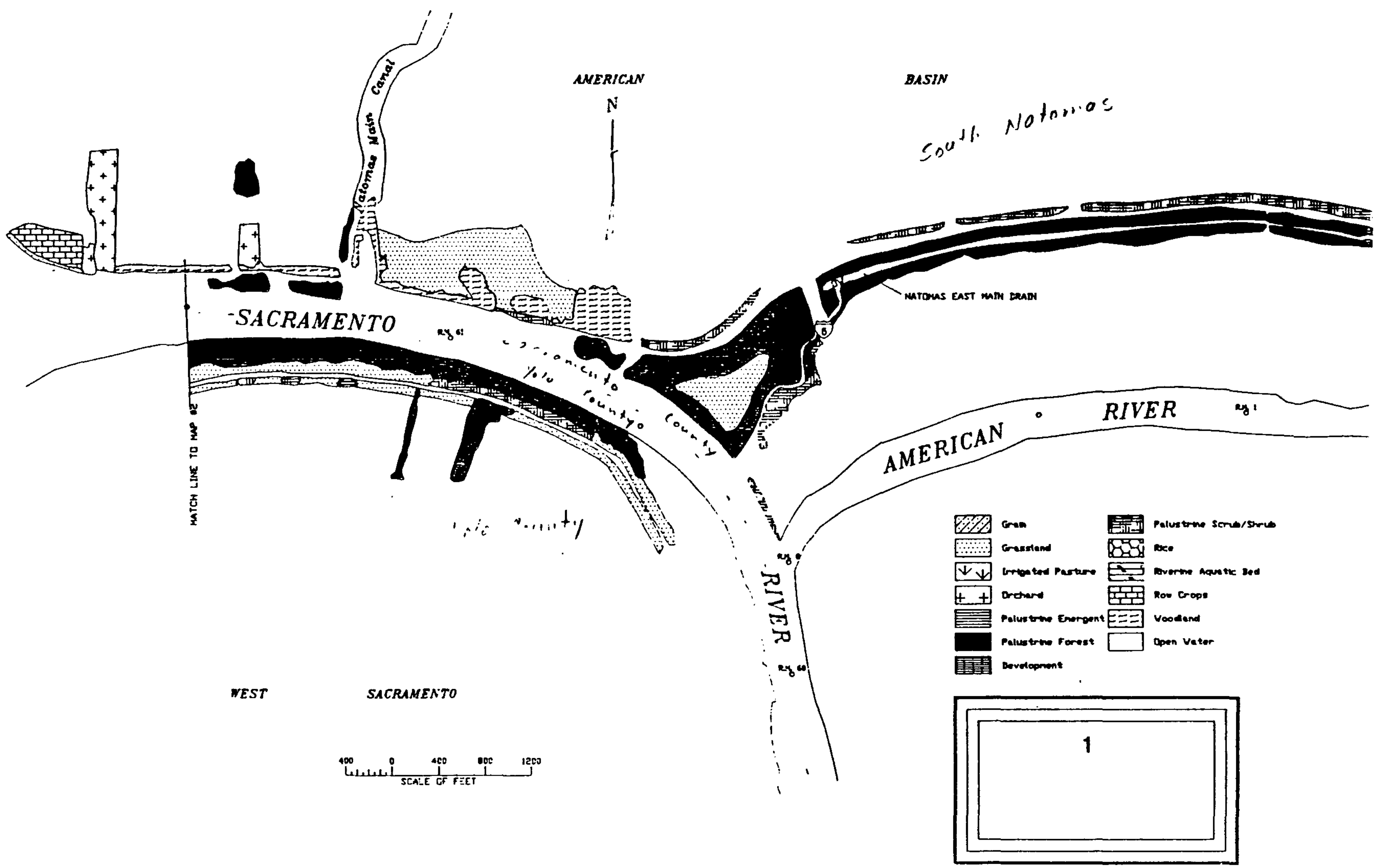
APPENDIX G

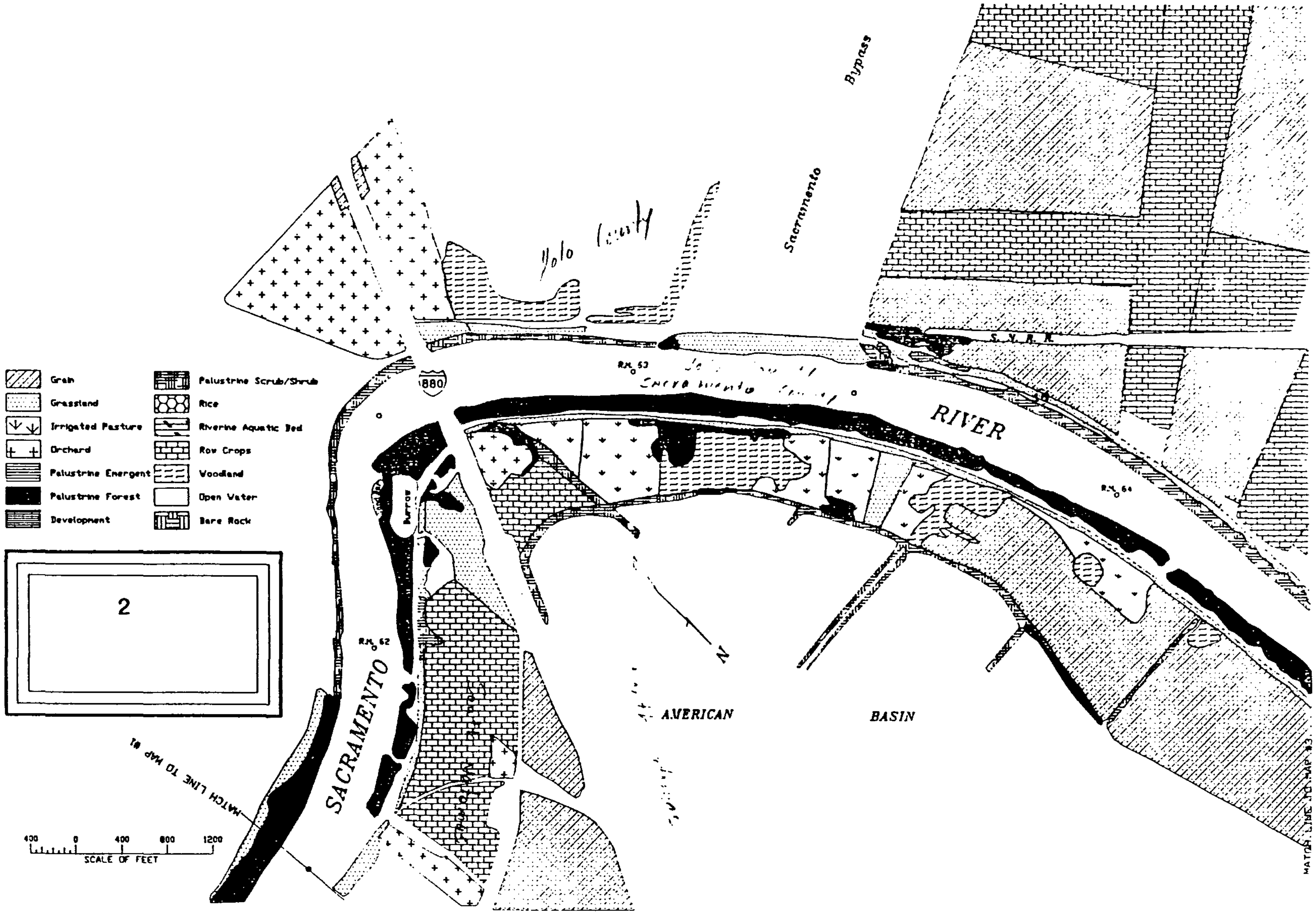
WILDLIFE COVER TYPES

SOILS

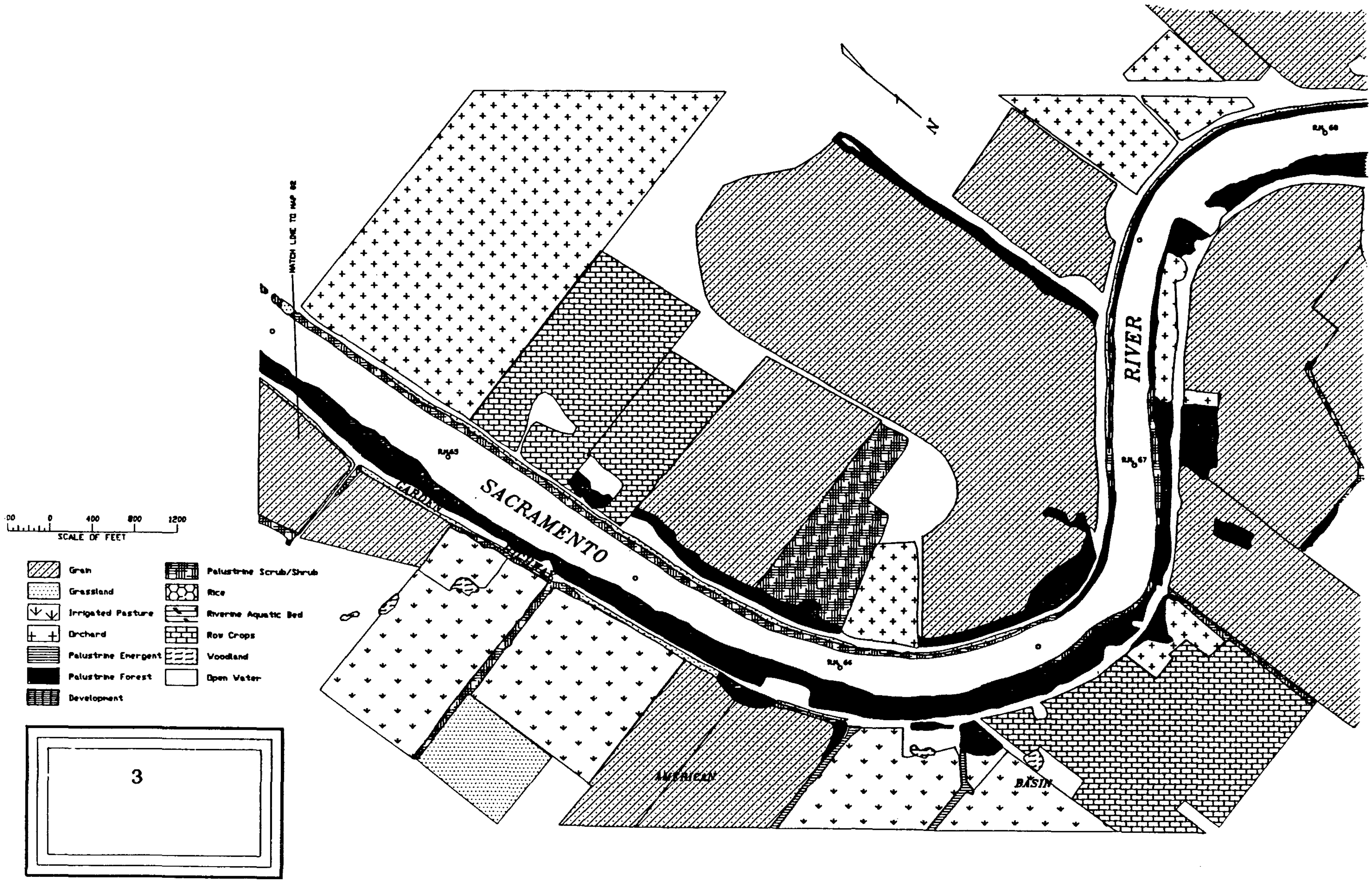
CROPS

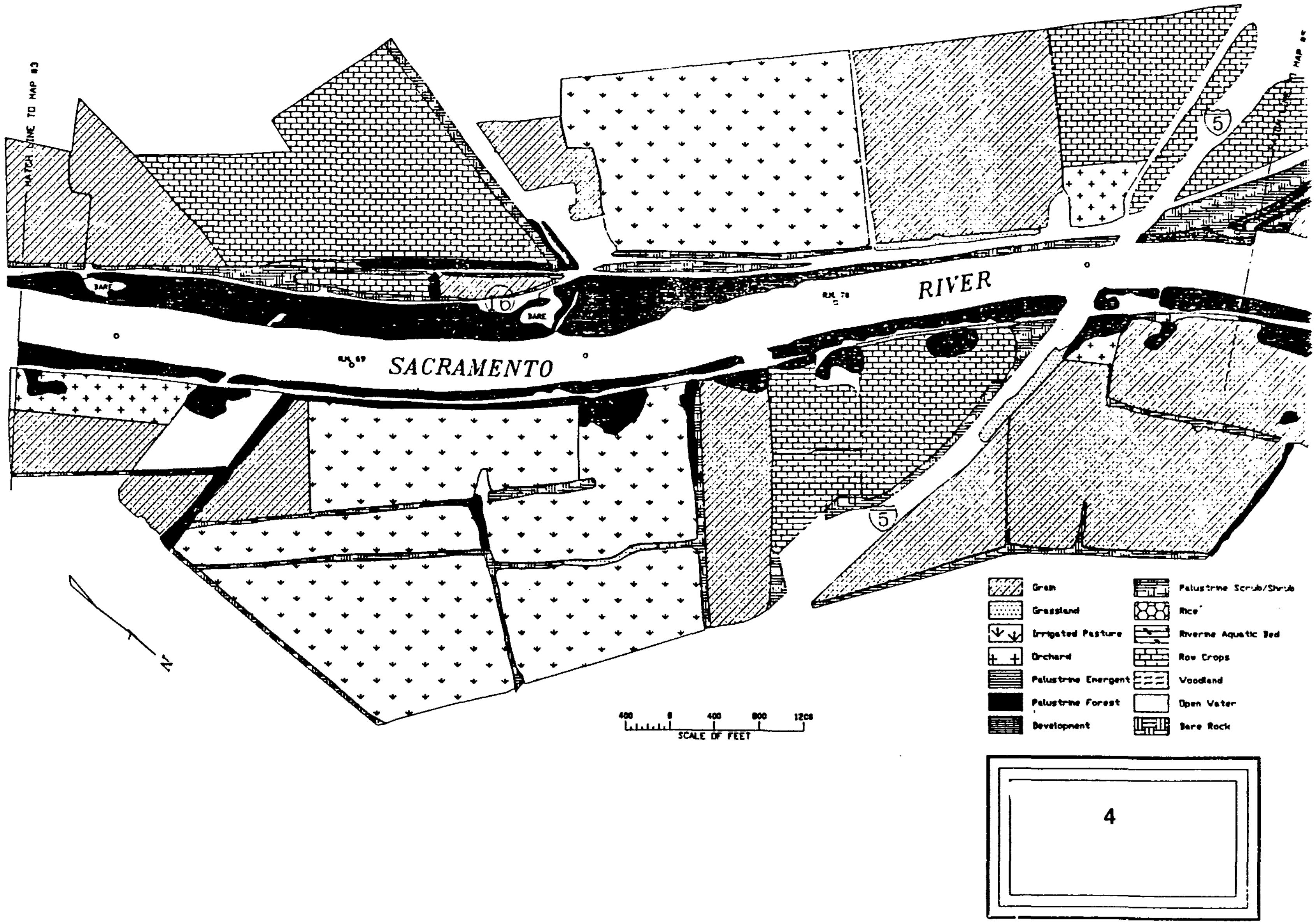
WILDLIFE COVER TYPES

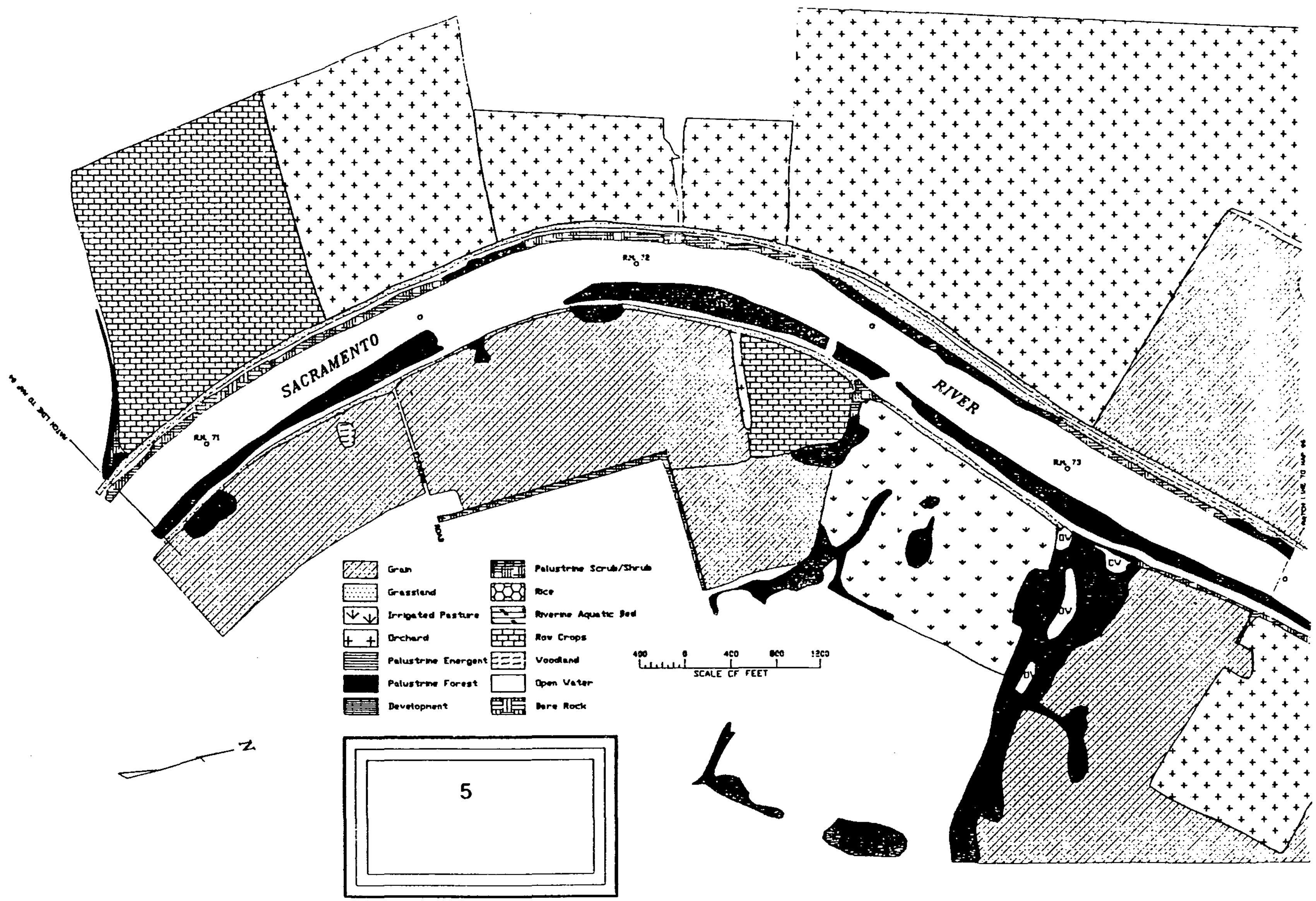

AMERICAN
BASIN
N
South Natomas
Natomas Main Canal
NATOMAS EAST MAIN DRAIN
SACRAMENTO
AMERICAN
RIVER
RIVER
MATCH LINE TO MAP #2
WEST
SACRAMENTO
400 0 400 800 1200
SCALE OF FEET
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
1



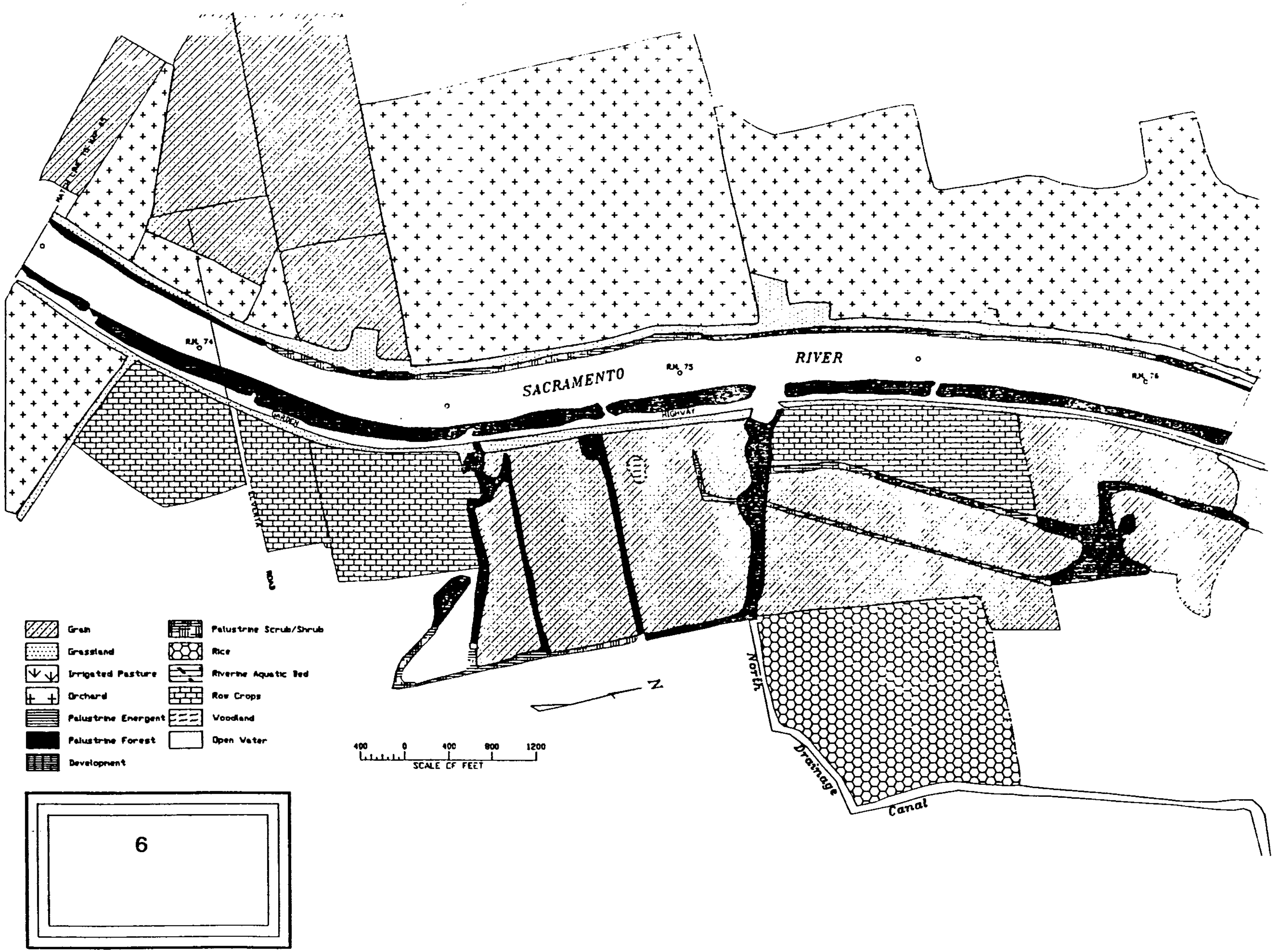
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
Bare Rock
2
400 0 400 800 1200
SCALE OF FEET
MATCH LINE TO MAP #1
MATCH LINE TO MAP #3
Yolo County
Sacramento Bypass
S.V.R.R.
880
R.M. 62
R.M. 63
R.M. 64
SACRAMENTO
RIVER
AMERICAN
BASIN
N

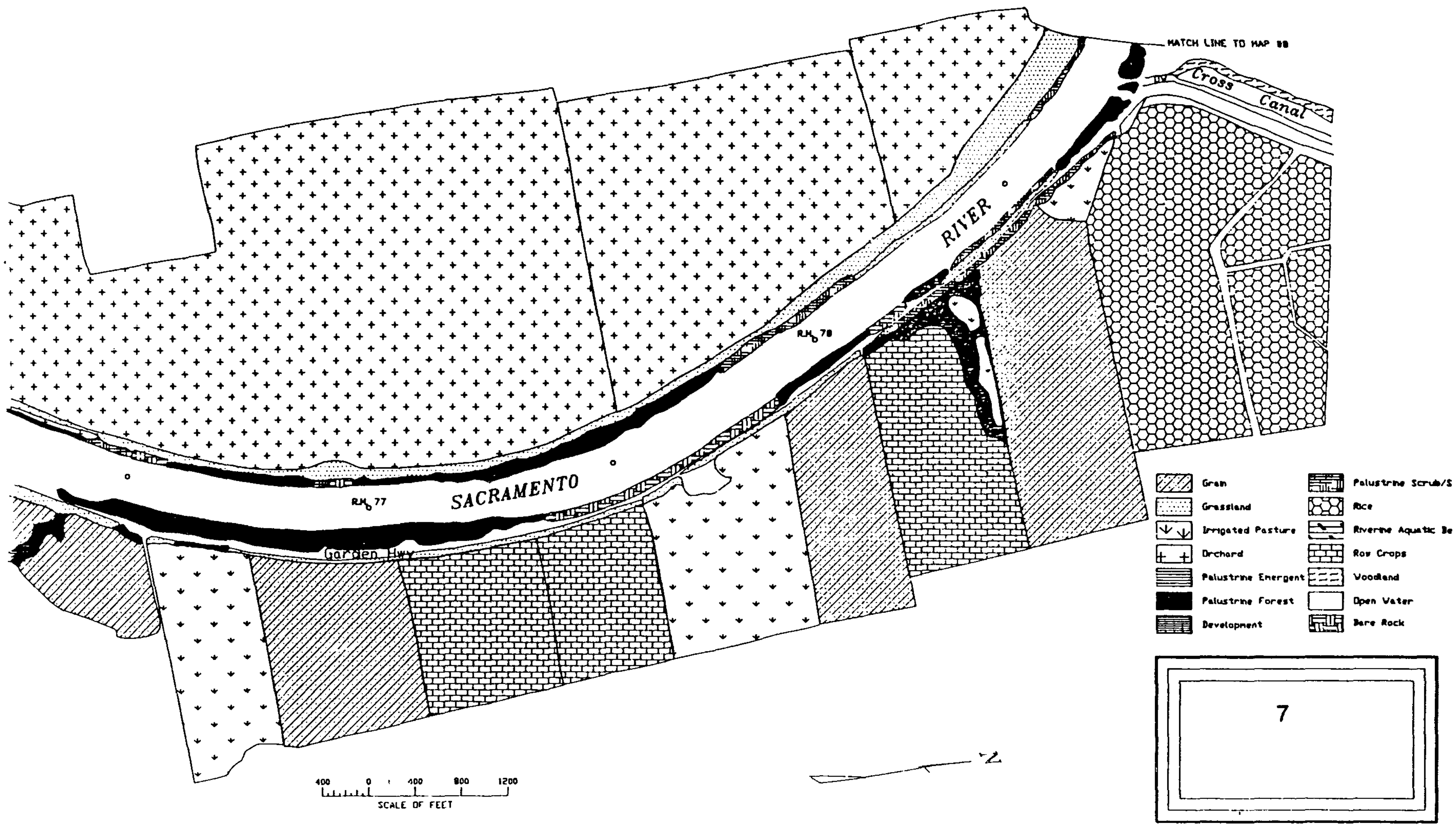

SACRAMENTO
RIVER
AMERICAN
BASIN
N
MATCH LINE TO MAP 02
R.M. 63
R.M. 66
R.M. 67
R.M. 68
SCALE OF FEET
00
0
400
800
1200
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
3


MATCH LINE TO MAP #3
SACRAMENTO
RIVER
BARE
BARE
5
5
N
400 0 400 800 1200
SCALE OF FEET
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
Bare Rock
4

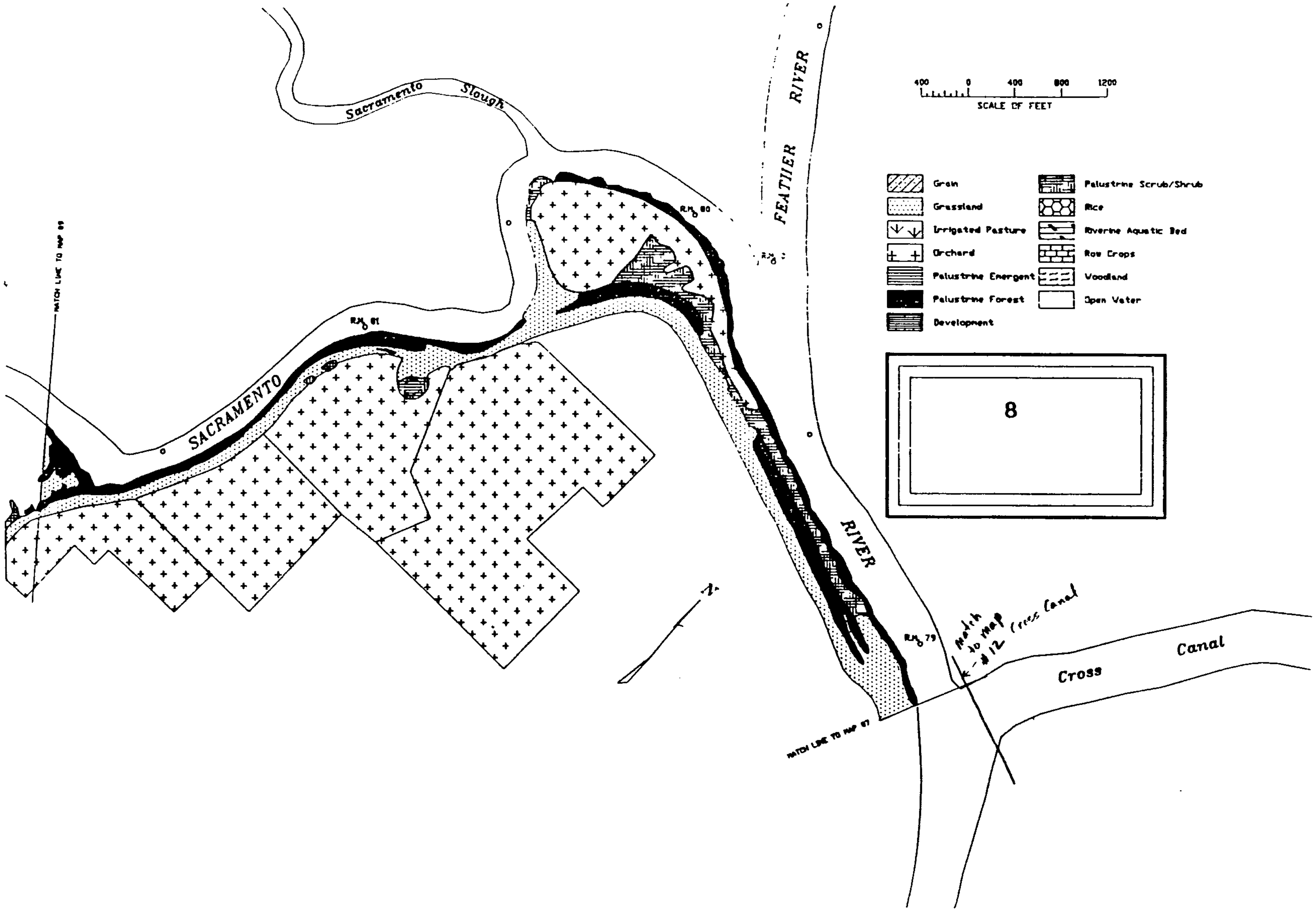


SACRAMENTO
RIVER
R.M. 71
R.M. 72
R.M. 73
OV
ROAD
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
Bare Rock
400 0 400 800 1200
SCALE OF FEET
N
5

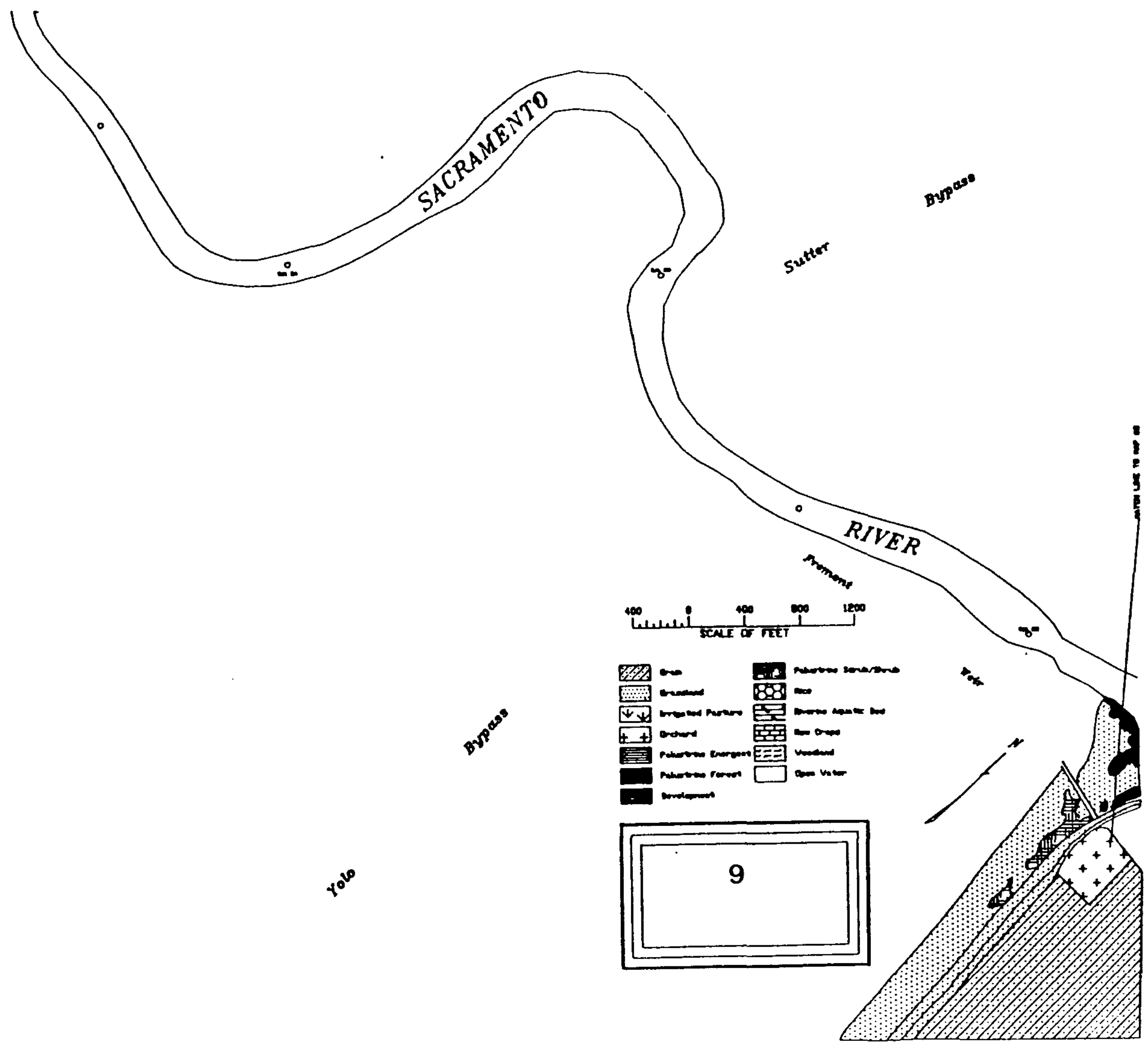

SACRAMENTO RIVER
R.M. 74
R.M. 75
R.M. 76
HIGHWAY
North Drainage Canal
N
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
400 0 400 800 1200
SCALE OF FEET
6



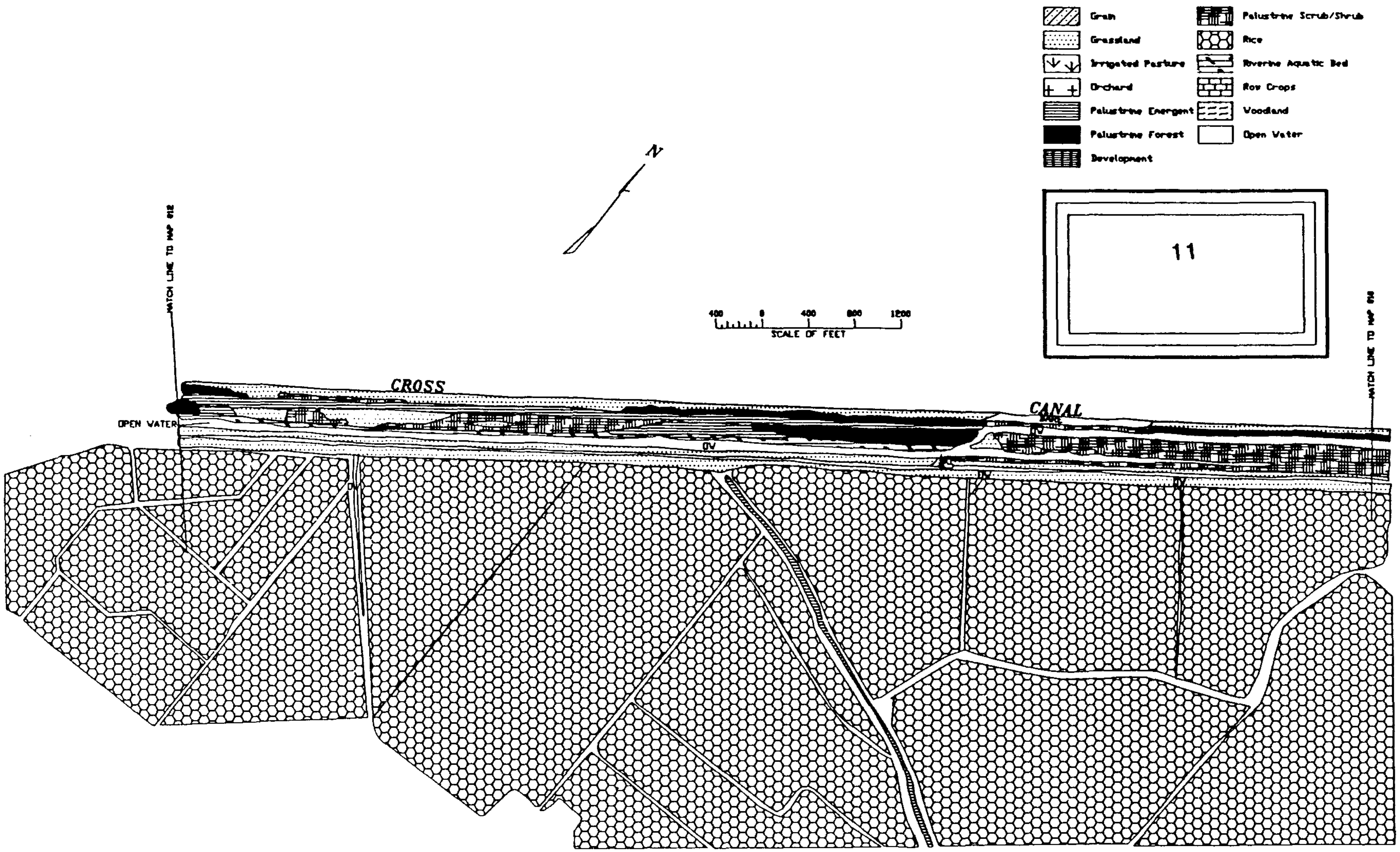
MATCH LINE TO MAP 8B
Cross Canal
RIVER
SACRAMENTO
R.M. 78
R.M. 77
Garden Hwy
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/S
Rice
Riverine Aquatic Be
Row Crops
Woodland
Open Water
Bare Rock
7
N
400 0 400 800 1200
SCALE OF FEET

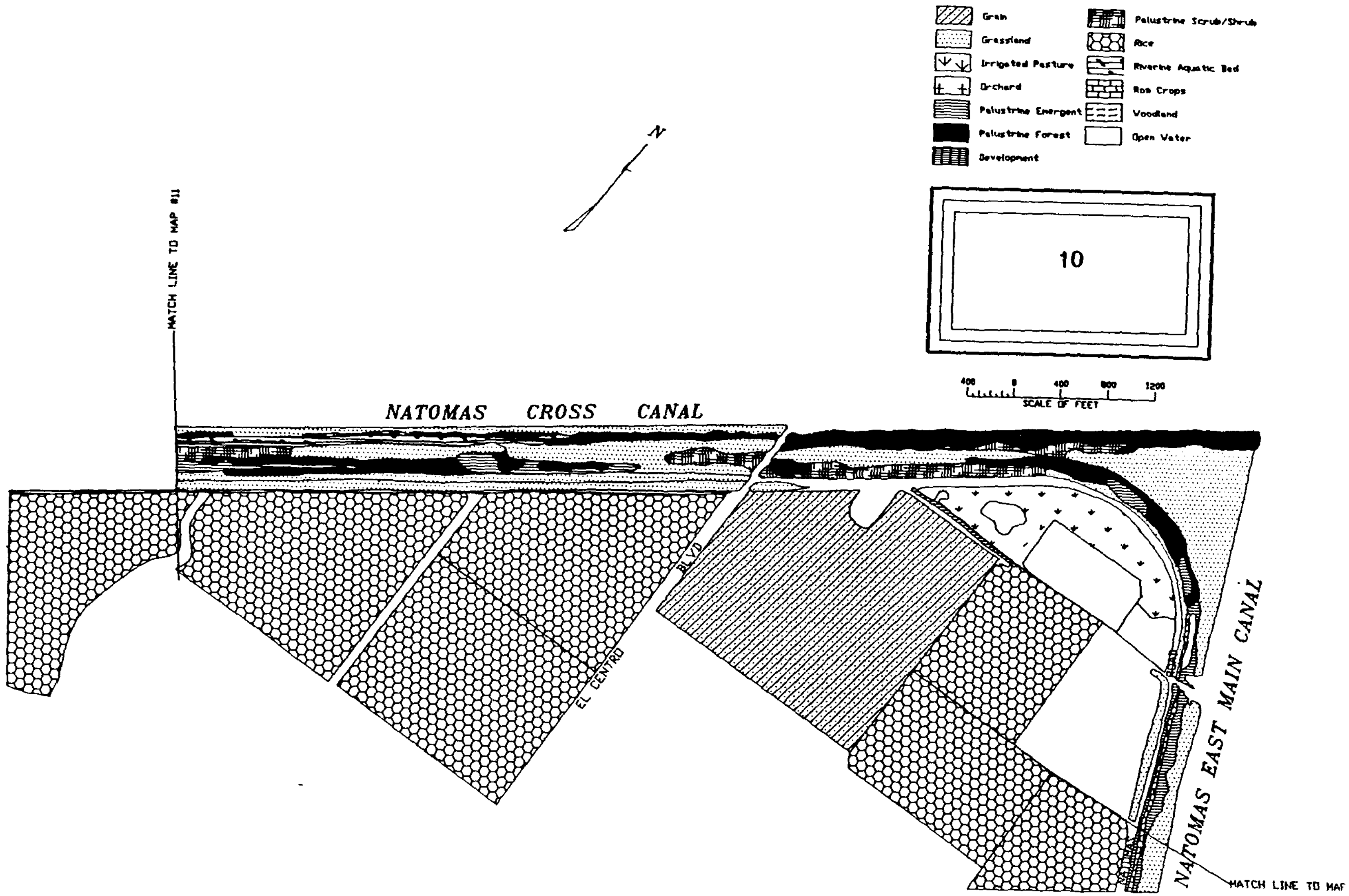


Sacramento Slough
FEATHER RIVER
SACRAMENTO
RIVER
Cross Canal
RM 81
RM 80
RM 79
MATCH LINE TO MAP 89
MATCH LINE TO MAP 87
match to map #12 Cross Canal
N
400 0 400 800 1200
SCALE OF FEET
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
8

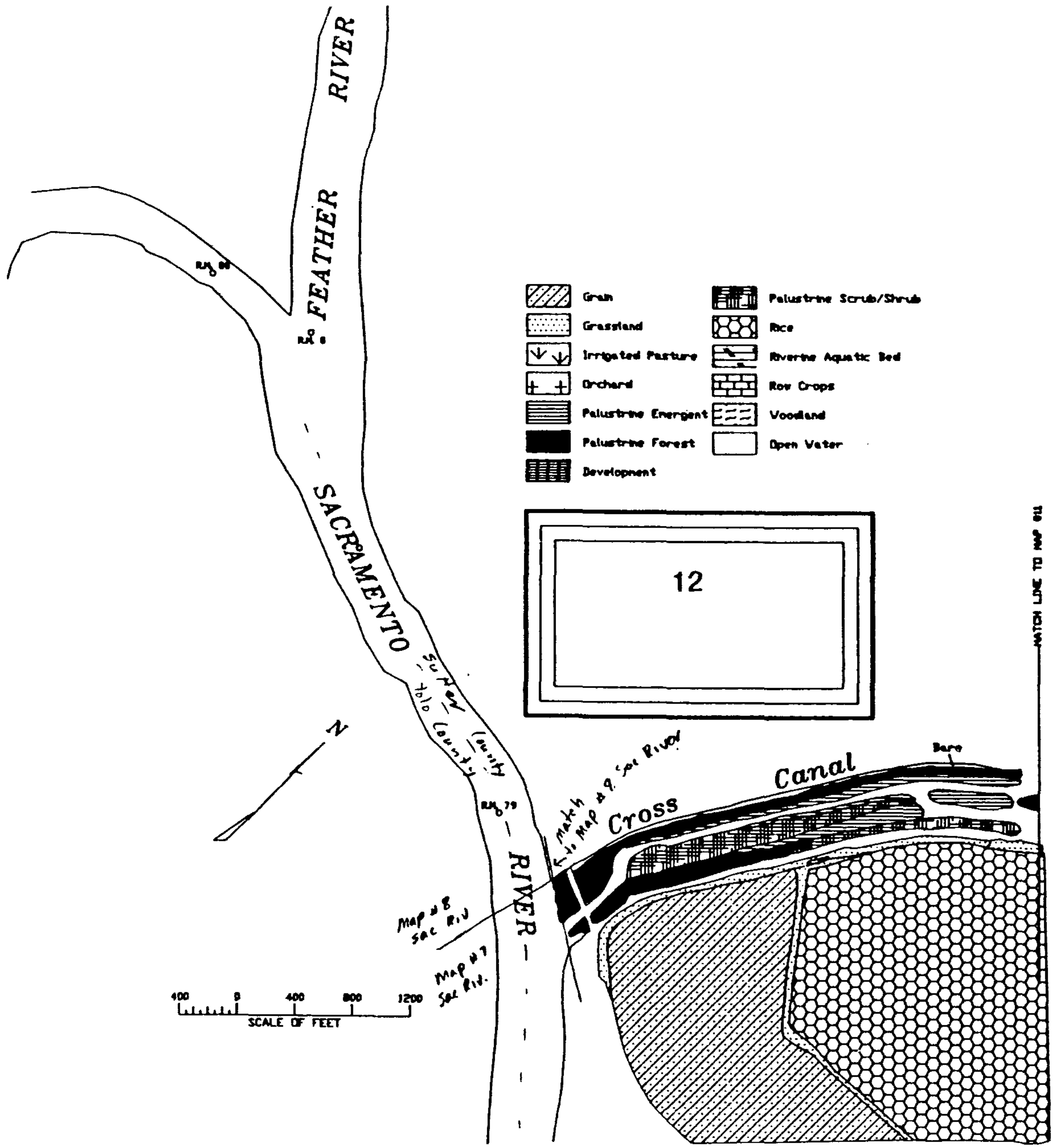


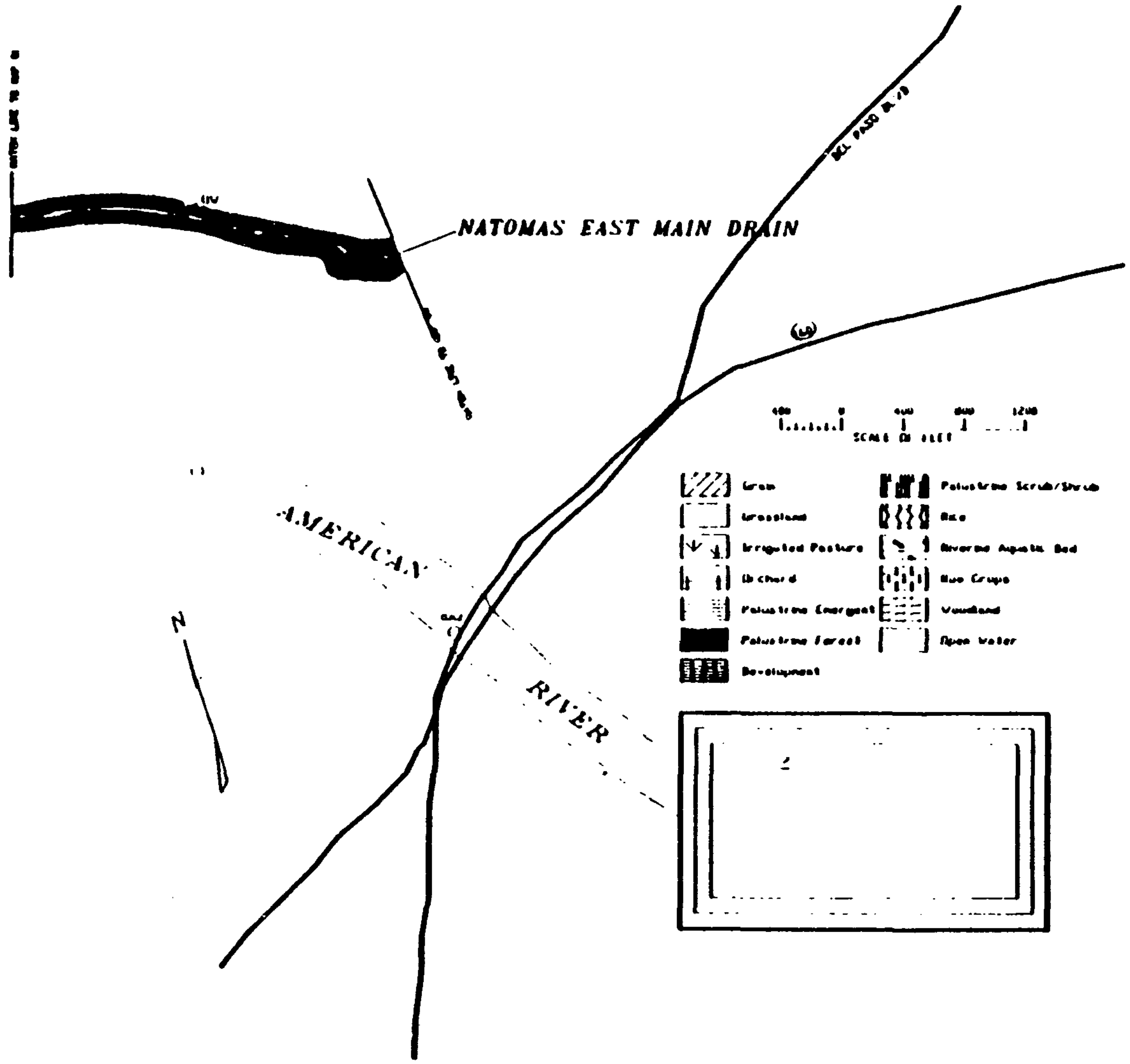
SACRAMENTO
RIVER
Sutter
Bypass
Fremont
Weir
Yolo
Bypass
400
0
400
800
1200
SCALE OF FEET
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
9


Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
11
N
400 0 400 800 1200
SCALE OF FEET
MATCH LINE TO MAP
MATCH LINE TO MAP
CROSS
CANAL
OPEN WATER
OV
OV

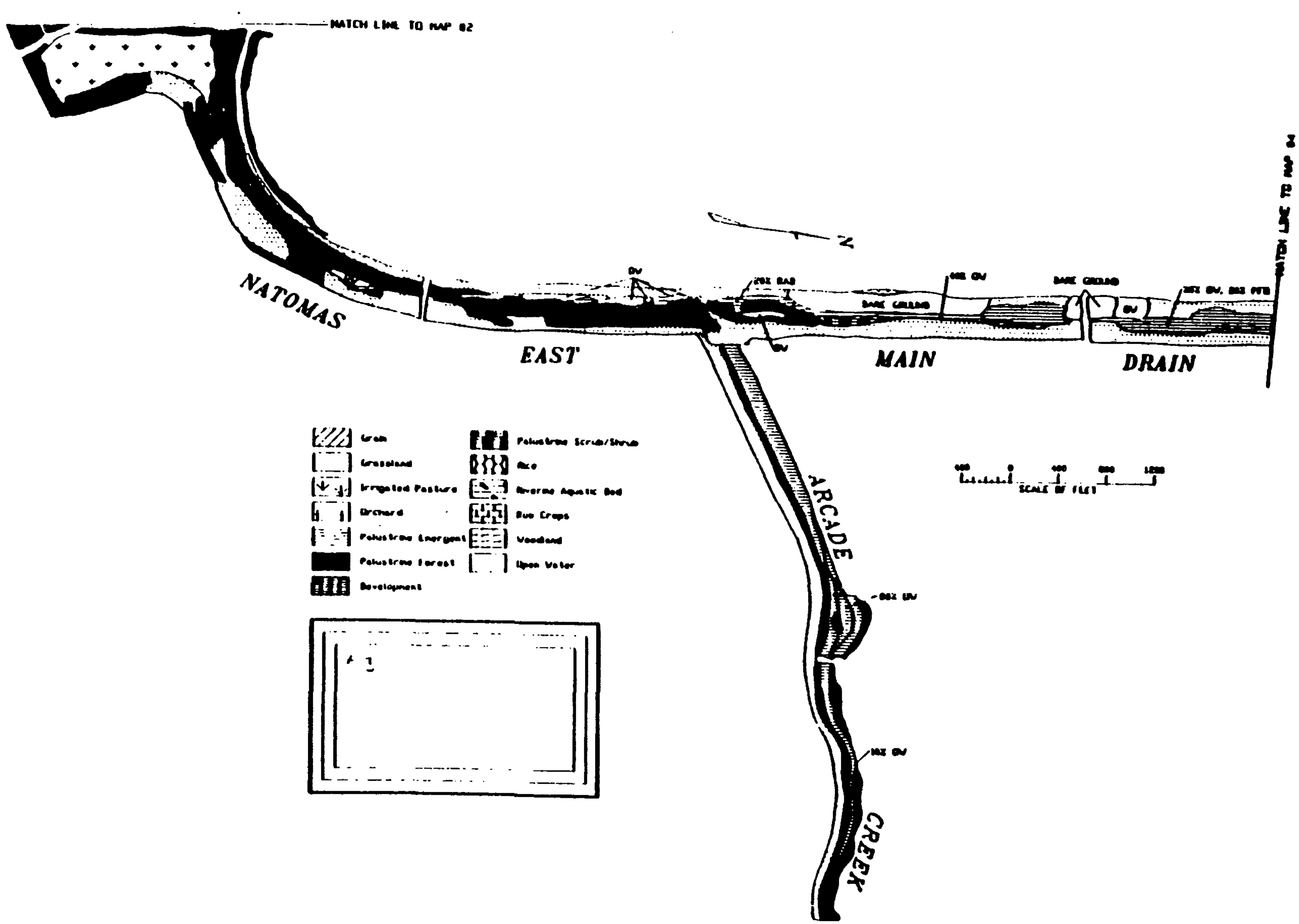


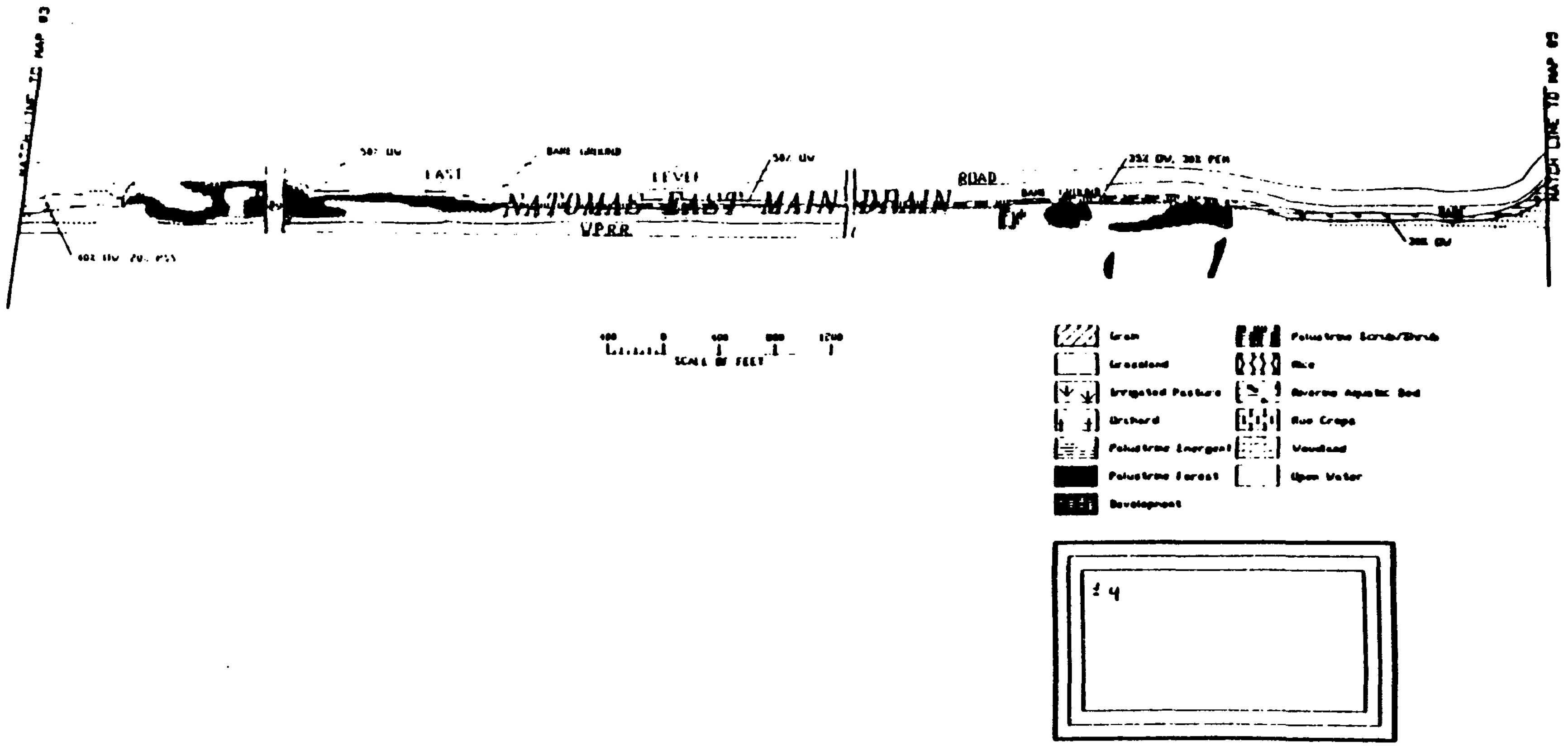
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
10
400 0 400 800 1200
SCALE OF FEET
N
MATCH LINE TO MAP #11
NATOMAS CROSS CANAL
EL CENTRO BLVD
NATOMAS EAST MAIN CANAL
MATCH LINE TO MAP

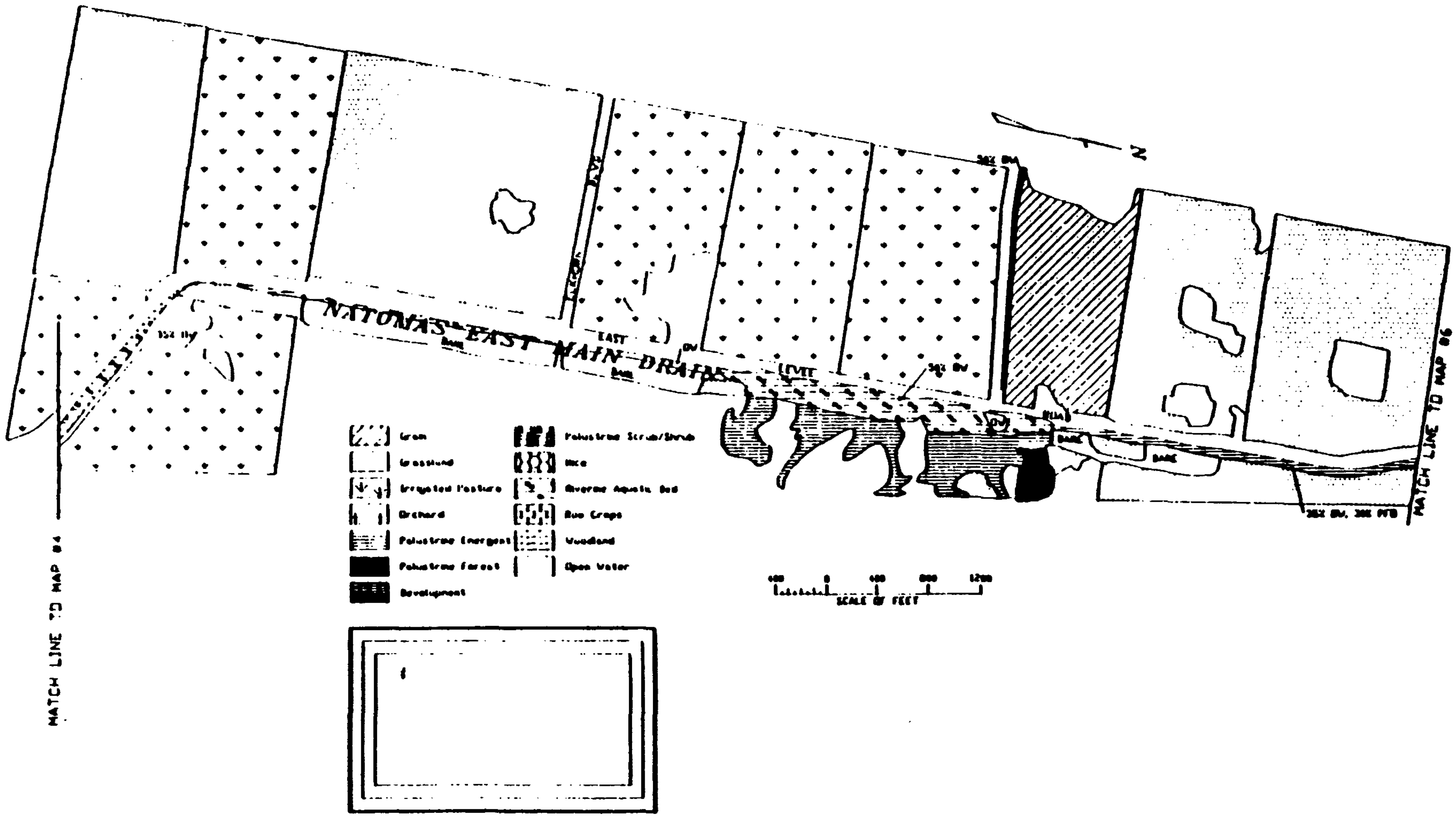

FEATHER RIVER
SACRAMENTO RIVER
Cross Canal
Bare
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
12
MATCH LINE TO MAP #11
Sutter County
Yolo County
match to Map #9 Sac River
Map #8 Sac Riv
Map #7 Sac Riv.
N
400 0 400 800 1200
SCALE OF FEET



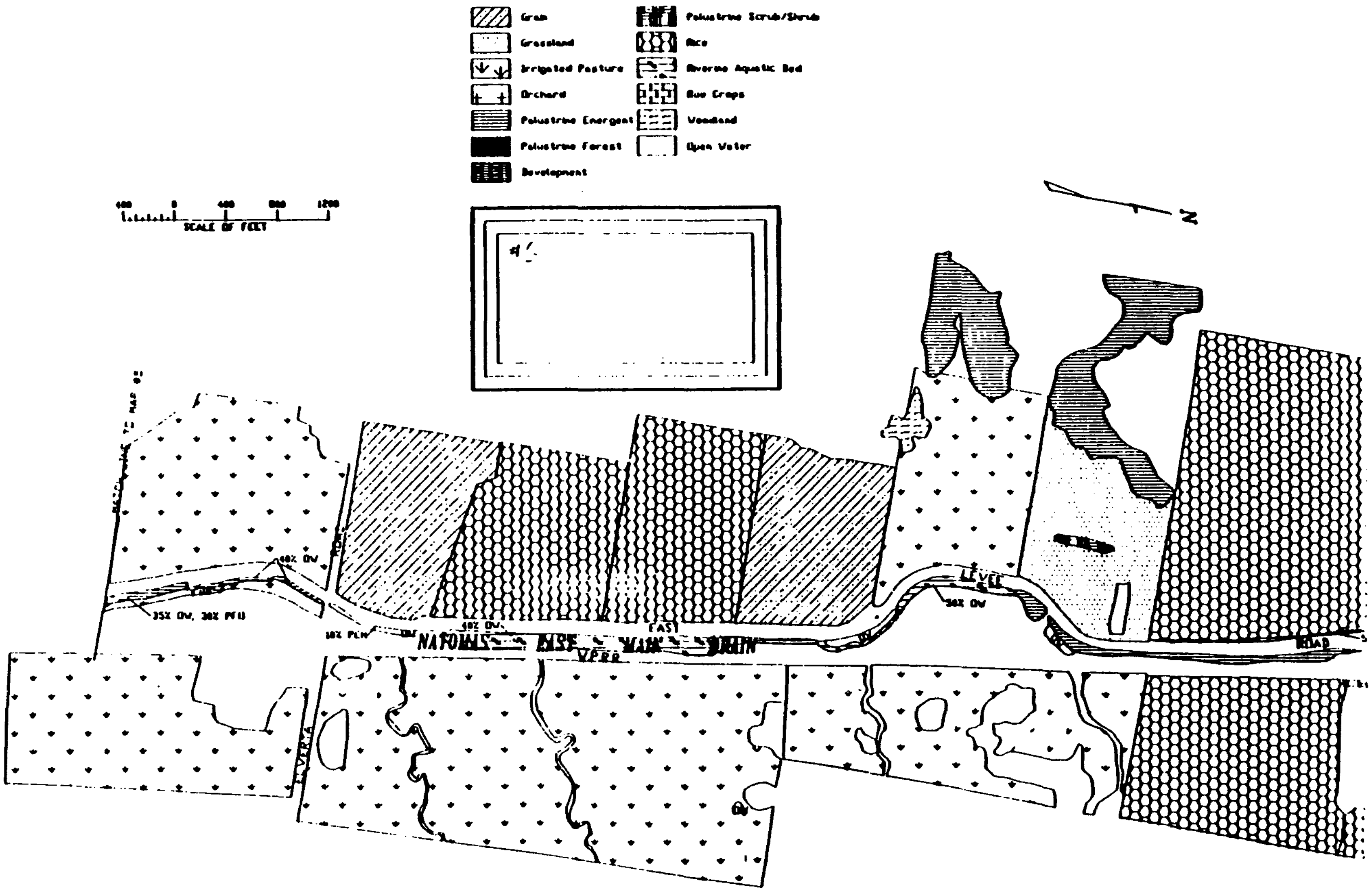
NATOMAS EAST MAIN DRAIN
AMERICAN RIVER
N
400 0 400 800 1200
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water

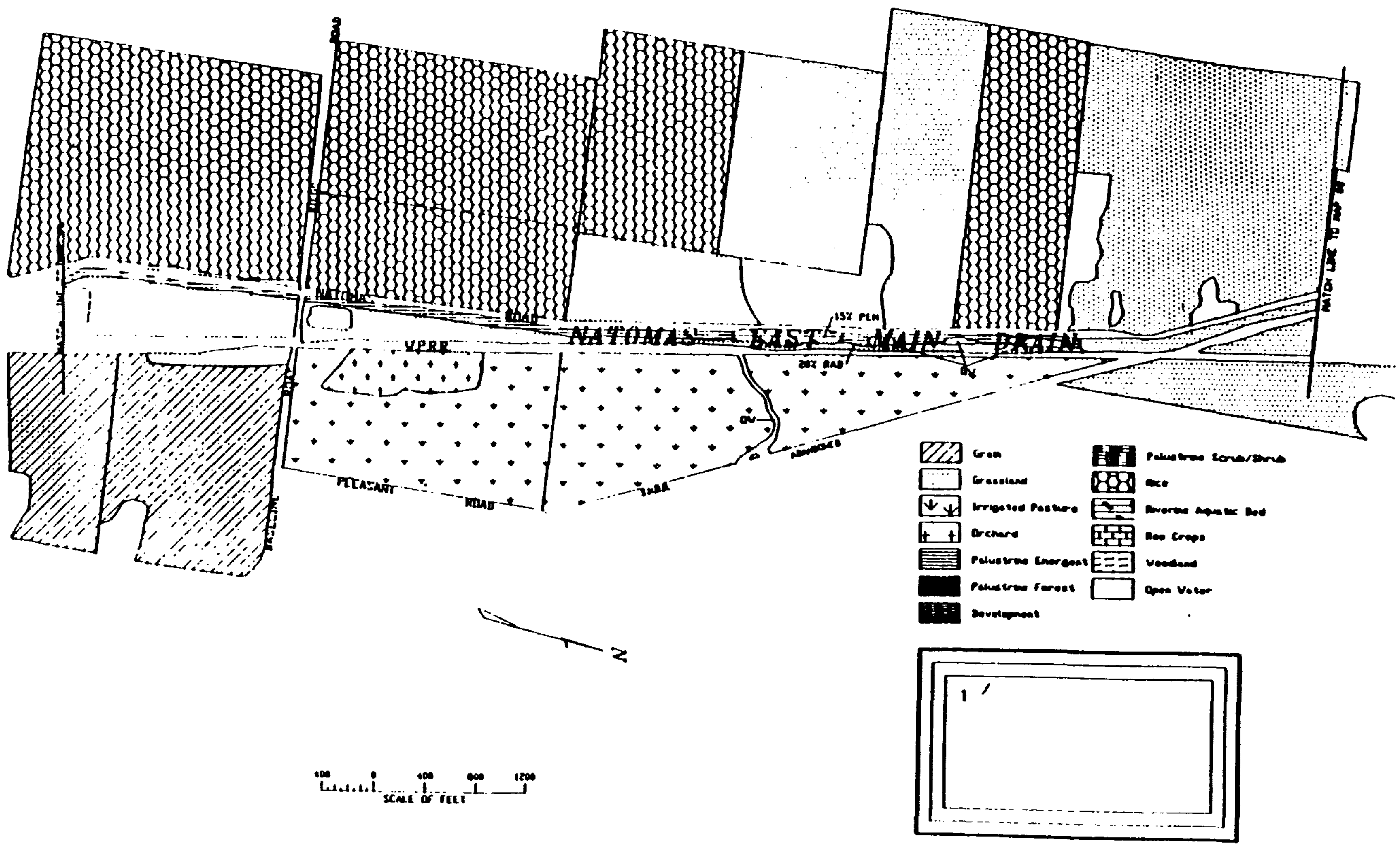

MATCH LINE TO MAP 02
MATCH LINE TO MAP 04
NATOMAS
EAST
MAIN
DRAIN
ARCADE
CREEK
BARE GROUND
BARE GROUND
N
400 0 400 800 1200
SCALE IN FEET
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water


MATCH LINE TO MAP 83
NATOMAS EAST MAIN DRAIN
EAST
LEVEE
ROAD
VPRR
BARE GROUND
35% OW, 30% PEM
30% OW
SCALE IN FEET
400 0 400 800 1200
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water



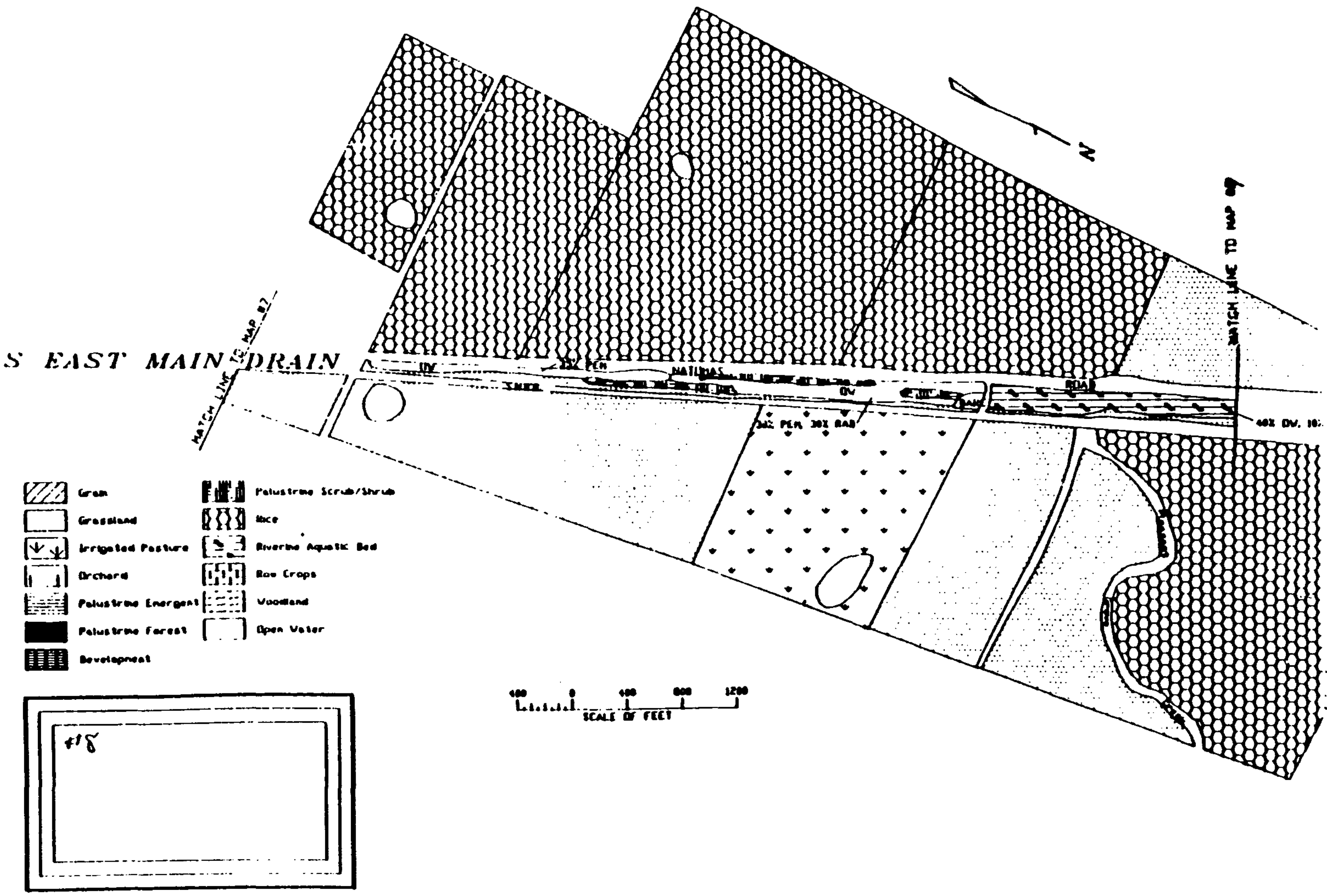
NATOMAS EAST MAIN DRAIN
LEVEE
EAST
N
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
400 0 400 800 1200
SCALE OF FEET
MATCH LINE TO MAP 04
MATCH LINE TO MAP 06

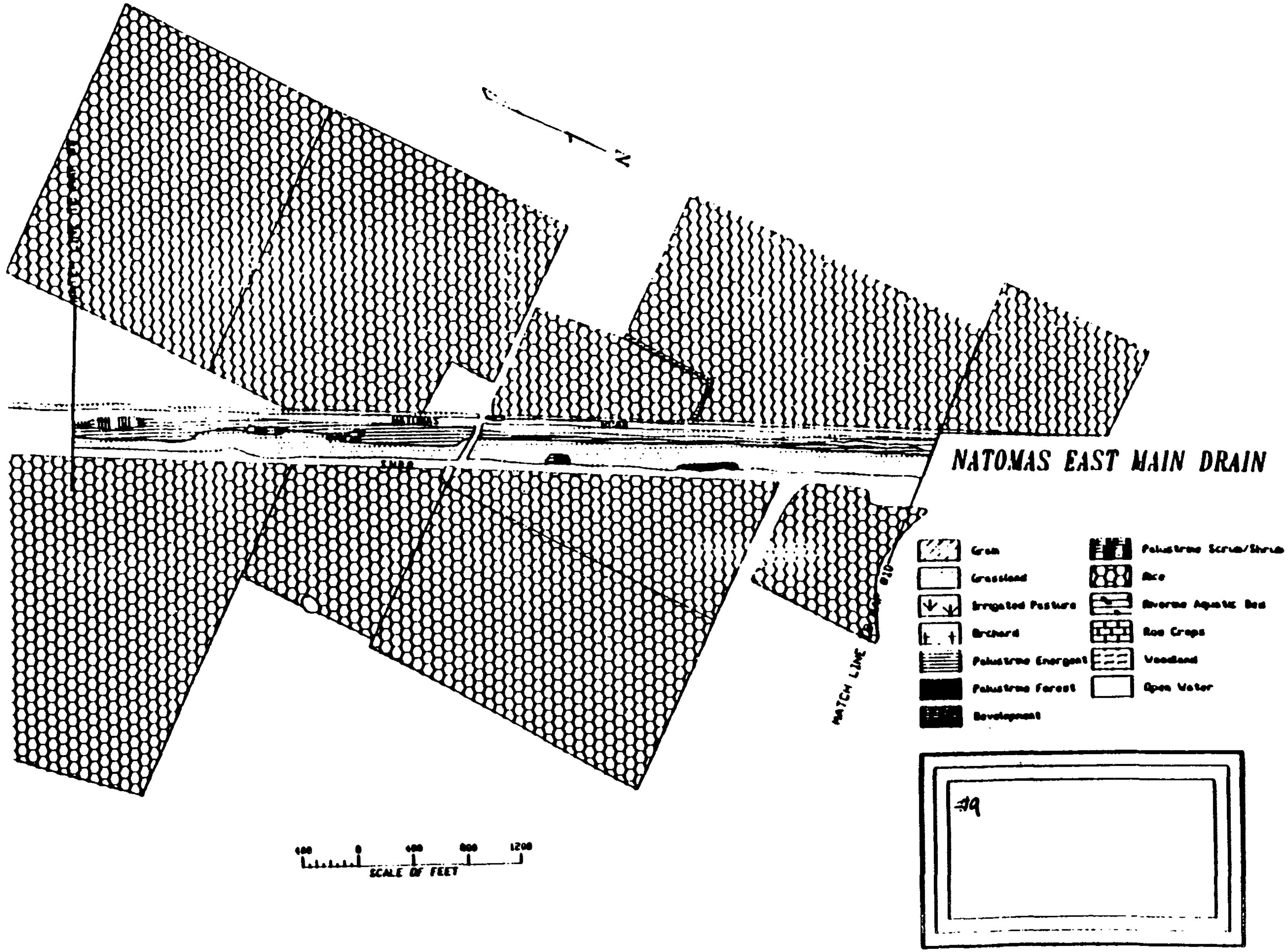

Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
400 0 400 800 1200
SCALE OF FEET
N
NATOMAS EAST MAIN DRAIN
UPRR
LEVEE
ROAD
35% OW, 30% PFO
40% OW
10% PEM
30% OW

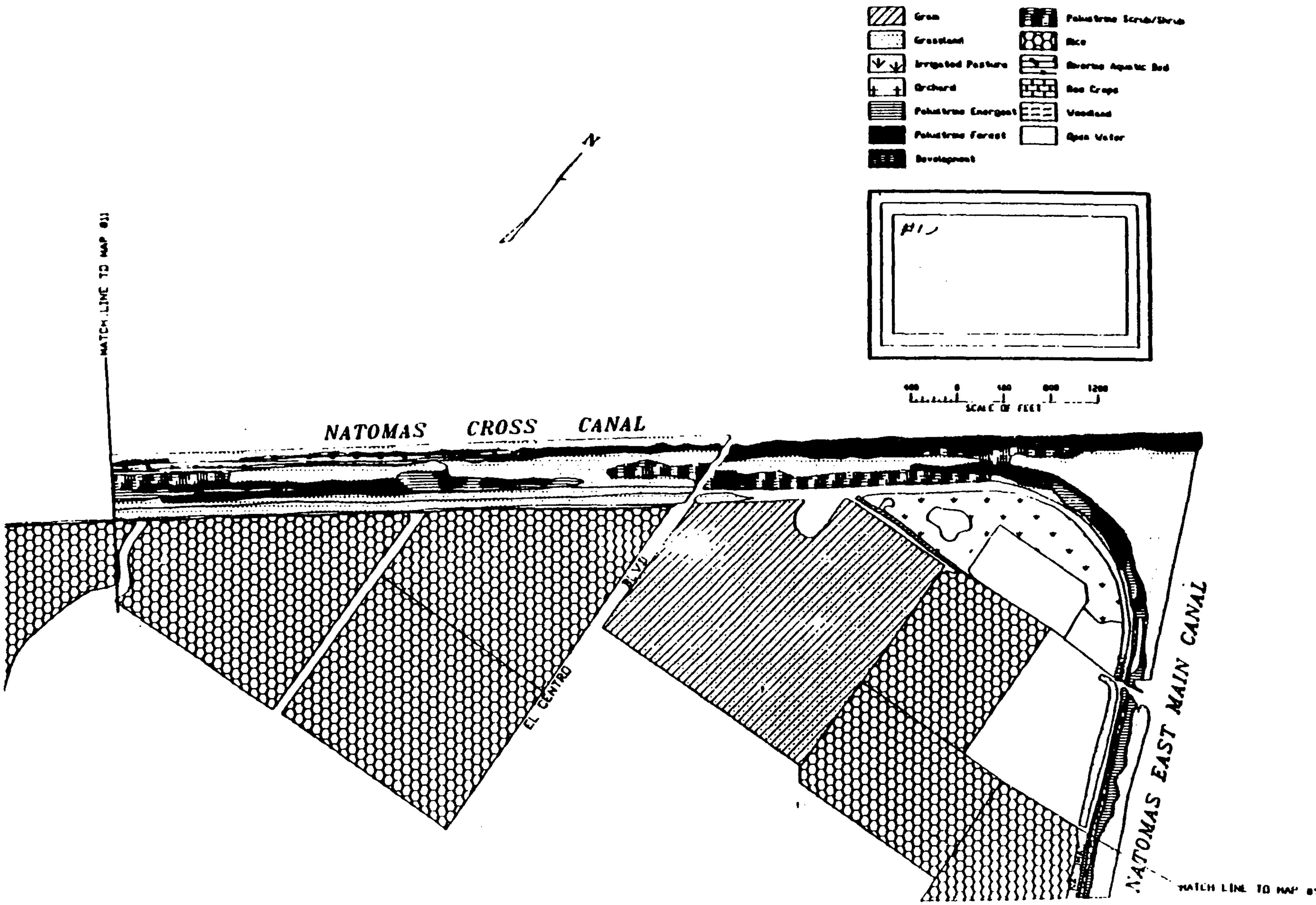


NATOMAS EAST MAIN DRAIN
NATOMAS ROAD
UPRR
PLEASANT ROAD
15% PEM
20% BAB
MATCH LINE TO MAP
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
N
SCALE OF FEET
400
0
400
800
1200

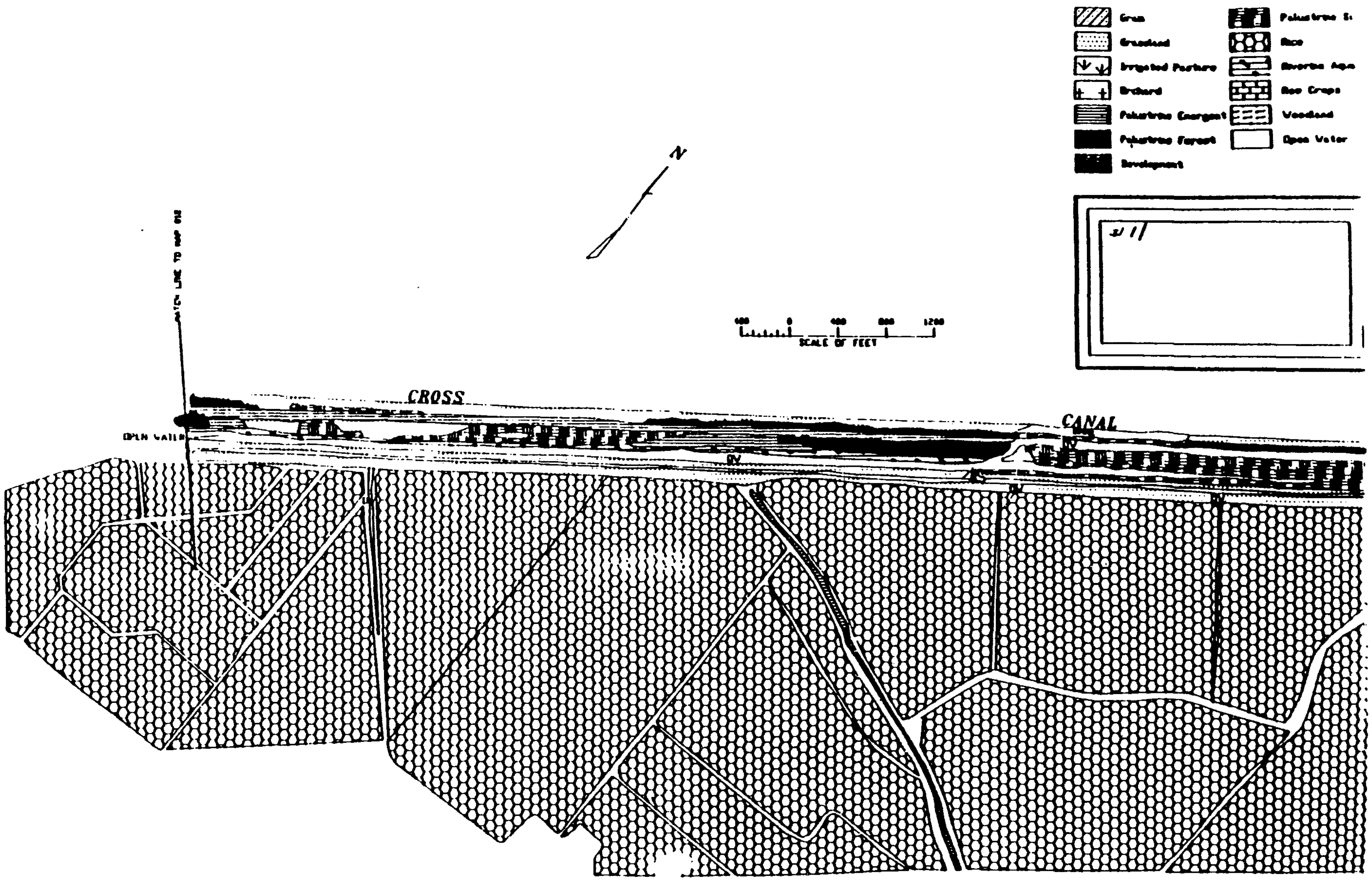
NATOMAS EAST MAIN DRAIN



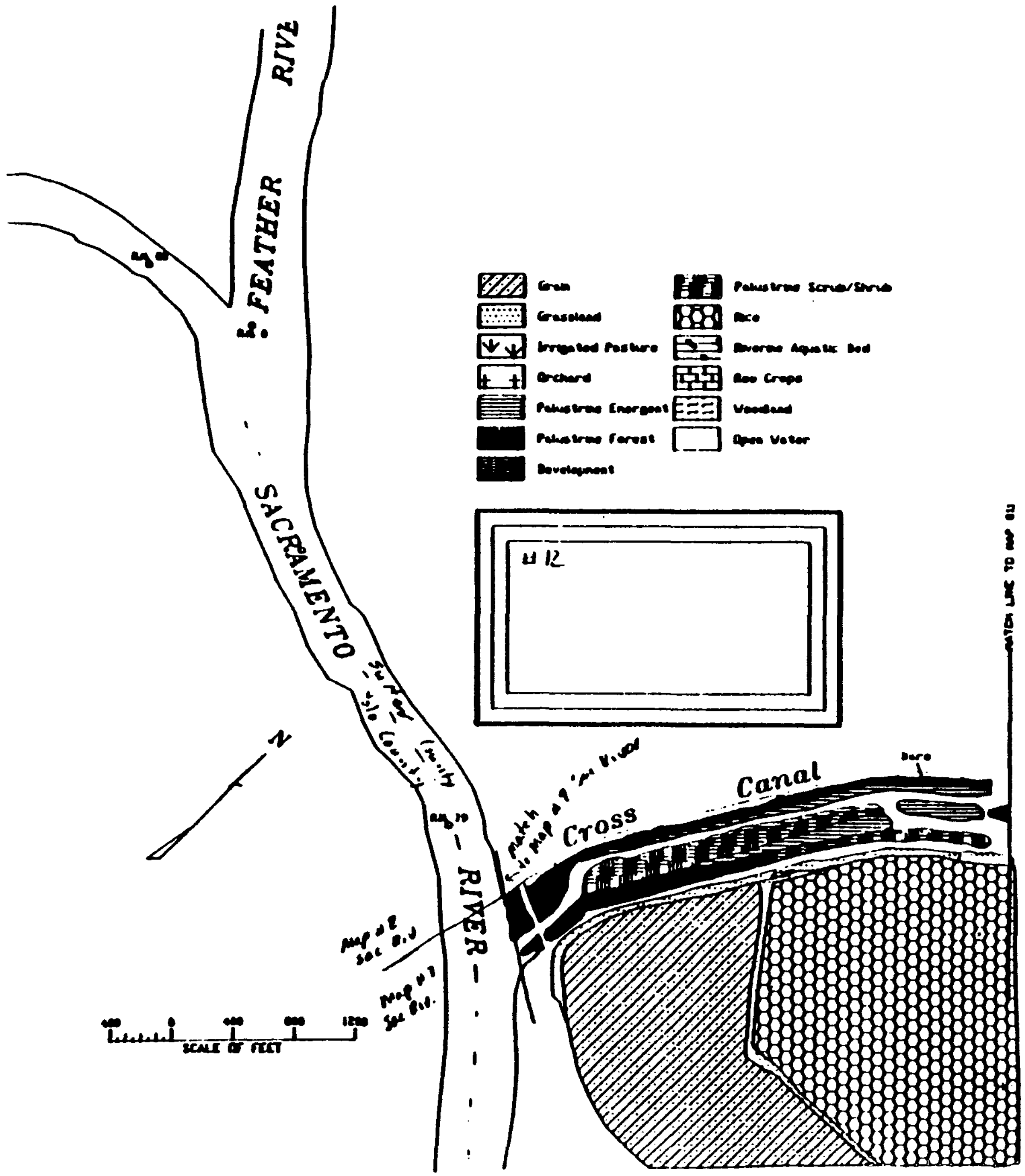

NATOMAS EAST MAIN DRAIN
N
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
MATCH LINE
#9
400 0 400 800 1200
SCALE OF FEET



NATOMAS CROSS CANAL
NATOMAS EAST MAIN CANAL
EL CENTRO
BLVD
MATCH LINE TO MAP #11
MATCH LINE TO MAP #9
N
#12
Palustrine Scrub/Shrub
Rice
Orchard
Row Crops
Palustrine Emergent
Woodland
Palustrine Forest
Open Water
Development
SCALE OF FEET
0
1200

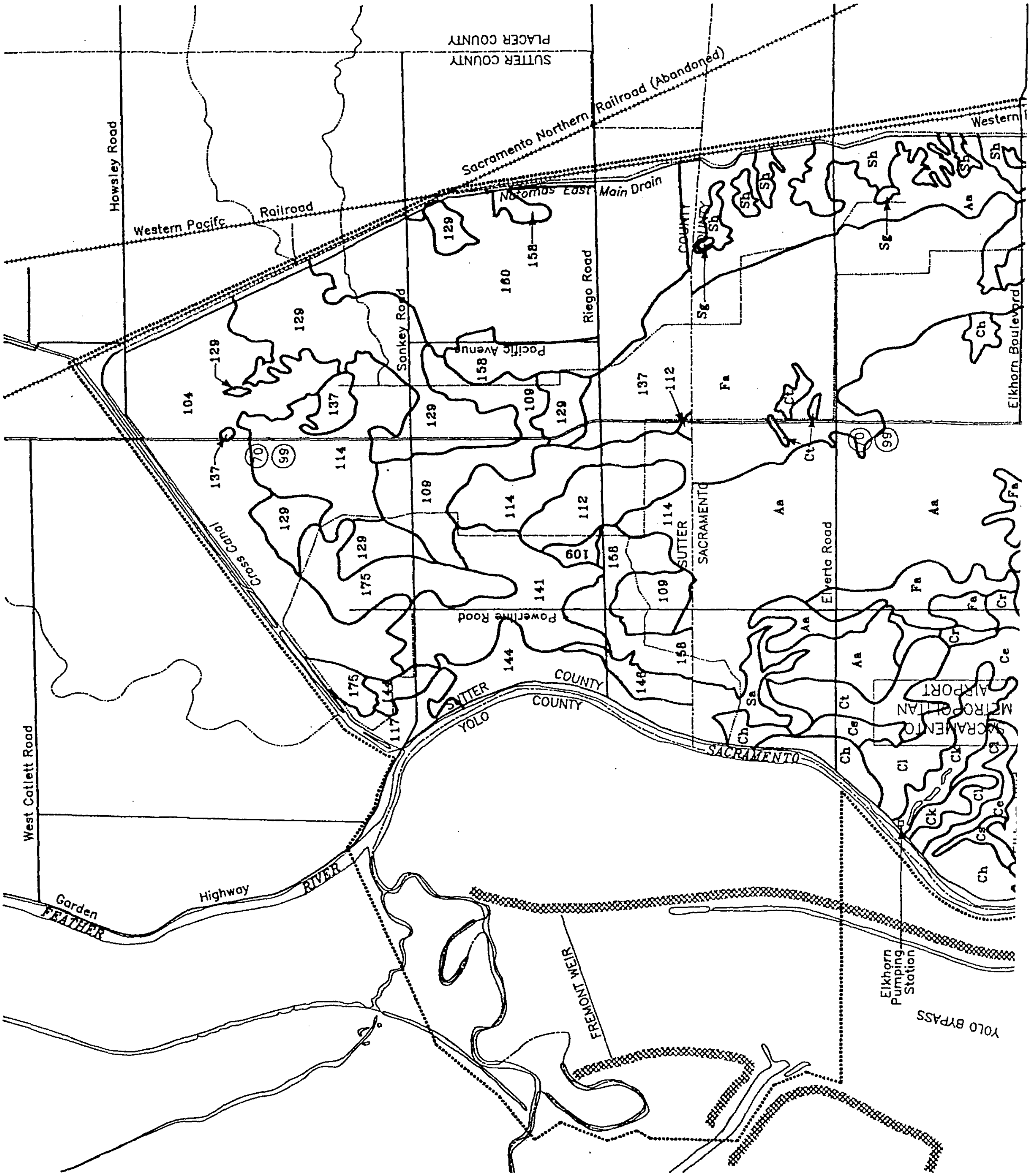


Grass
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Rice
Row Crops
Woodland
Open Water
N
SCALE OF FEET
400
0
400
800
1200
CROSS
CANAL
OPEN WATER



FEATHER
RIVE
SACRAMENTO
RIVER
Cross
Canal
Grain
Grassland
Irrigated Pasture
Orchard
Palustrine Emergent
Palustrine Forest
Development
Palustrine Scrub/Shrub
Rice
Riverine Aquatic Bed
Row Crops
Woodland
Open Water
MATCH LINE TO MAP 811
SCALE OF FEET
400
0
400
800
1200
N

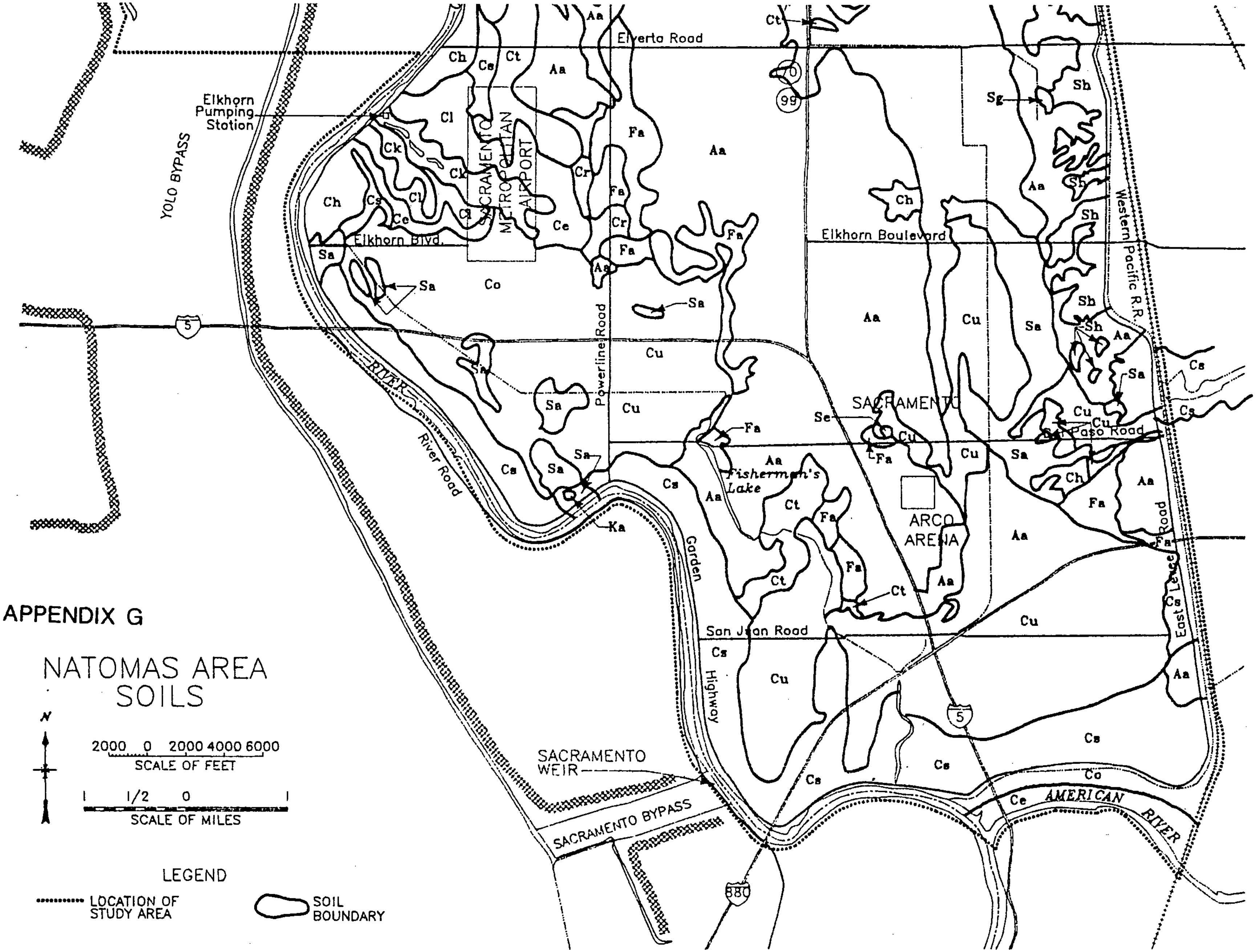
SOILS


PLACER COUNTY
SUTTER COUNTY
Sacramento Northern Railroad (Abandoned)
Western Pacific Railroad
Western
Natomas East Main Drain
Howsley Road
Sankey Road
Riego Road
Pacific Avenue
Elkhorn Boulevard
Elverta Road
Powerline Road
Cross Canal
West Catlett Road
Garden Highway
FEATHER RIVER
SUTTER COUNTY
YOLO COUNTY
SACRAMENTO
SUTTER
COUNTY
SACRAMENTO METROPOLITAN AIRPORT
FREMONT WEIR
Elkhorn Pumping Station
YOLO BYPASS
70
99
104
109
112
114
117
129
137
141
144
146
158
160
175
Aa
Ce
Ch
Cl
Ck
Cr
Cs
Ct
Fa
Sa
Sg
Sh

2

APPENDIX G

NATOMAS AREA SOILS



Sacramento County
Source: U.S. Dept. of Agriculture, Soil Conservation Service, 1954.

D – Drainage characteristics
V – Vegetation characteristics
Aa – Alamo clay (adobe)
(D)—only slightly permeable
(V)—rice, grain, hay
Ce – Columbia fine sandy loam
Cg – Columbia fine sandy loam (over Freeport clay)

Co – Columbia silt loam
Cs – Columbia silt loam (over Sacramento silty clay loam)
Ct – Columbia silty clay (over Freeport clay)
Cu – Columbia silty clay (over Sacramento silty clay)

Sutter County
Source: U.S. Dept. of Agriculture, Soil Conservation Service, 19

Prime farmland (as designated by SCS):

104 – Capay silty clay
very deep, moderately well drained soil
109 – Capay clay, hardpan substratum
deep, moderately well drained soil
112 – Clear Lake clay
very deep; poorly drained under natural conditions, improved drainage with open ditches and flood control

Other soils:

129 – Galt clay
moderately deep, moderately well–drained soil
137 – Jacktone Clay
poorly drained under natural conditions; improved drainage with open ditches and flood

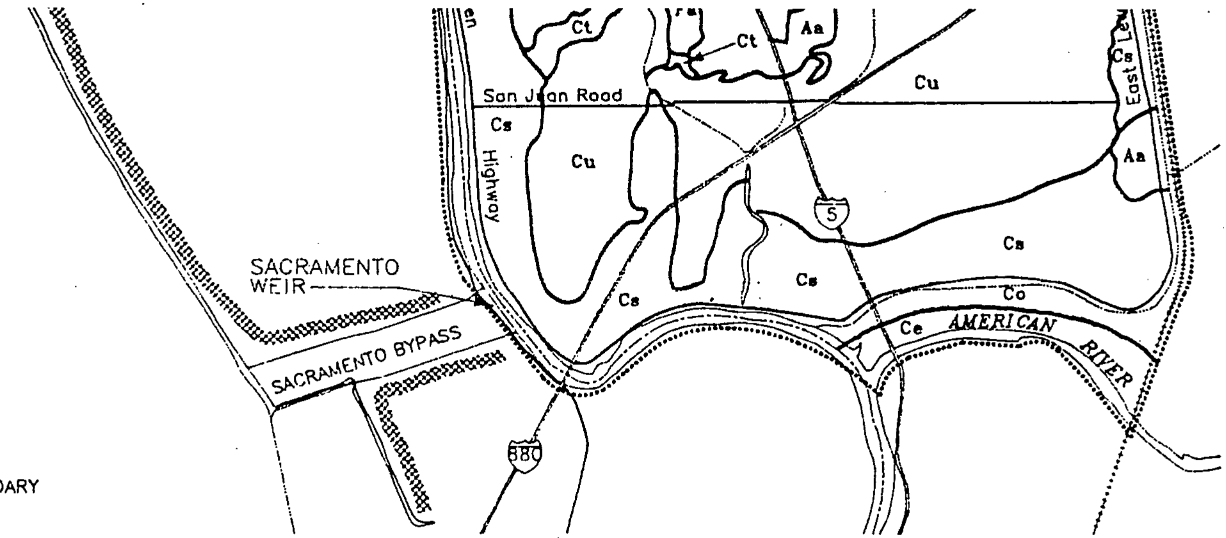
APPENDIX G

NATOMAS AREA SOILS

N

2000 0 2000 4000 6000
SCALE OF FEET

1 1/2 0 1
SCALE OF MILES



LEGEND

LOCATION OF STUDY AREA

SOIL BOUNDARY

3

Sacramento County
Source: U.S. Dept. of Agriculture, Soil Conservation Service, 1954.

- D – Drainage characteristics
- V – Vegetation characteristics
- Aa – Alamo clay (adobe)
  (D)–only slightly permeable
  (V)–rice, grain, hay
- Ce – Columbia fine sandy loam
- Cg – Columbia fine sandy loam (over Freeport clay)
- Ck – Columbia loamy fine sand
- Cl – Columbia loamy fine sand
- Cn – Columbia loamy fine sand (over Freeport clay)
- Co – Columbia silt loam
- Cs – Columbia silt loam (over Sacramento silty clay loam)
- Ct – Columbia silty clay (over Freeport clay)
- Cu – Columbia silty clay (over Sacramento silty clay)
- Fa – Freeport clay (adobe)
- Sa – Sacramento silty clay loam
- Se – San Joaquin loam
- Sg – San Joaquin sandy loam, deep
- Sh – San Joaquin sandy loam

Sutter County
Source: U.S. Dept. of Agriculture, Soil Conservation Service, 19

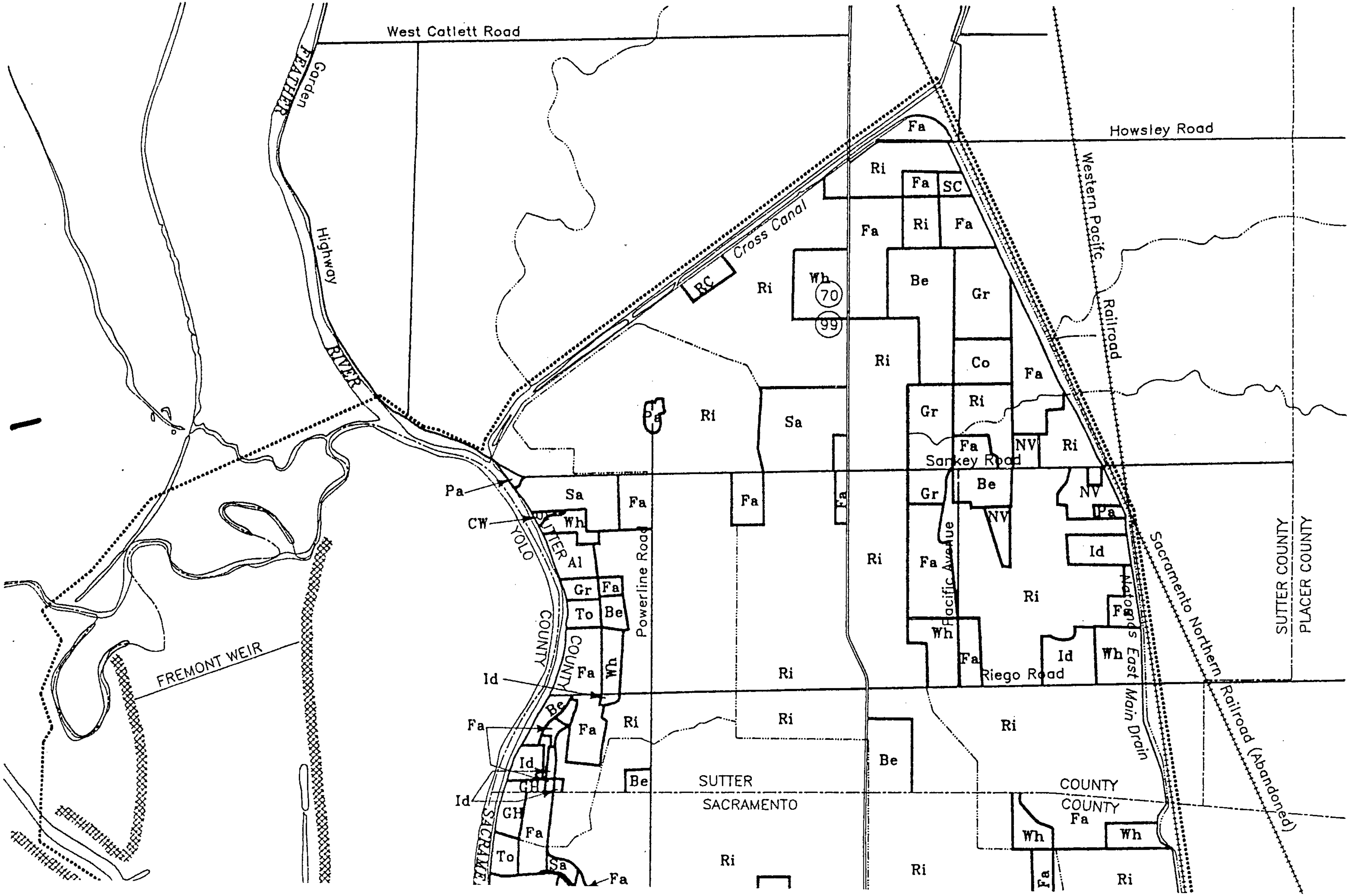
Prime farmland (as designated by SCS):

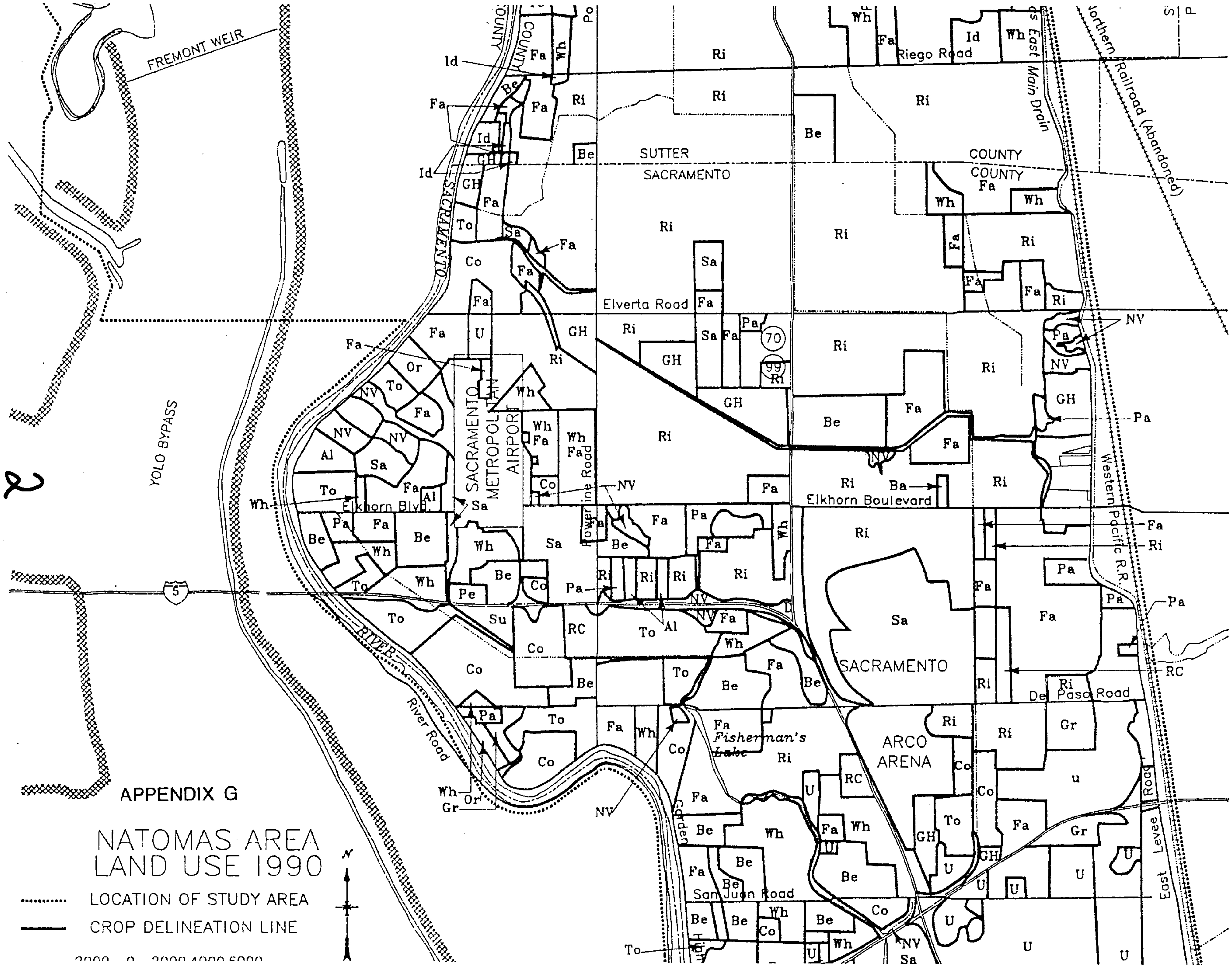
- 104 – Capay silty clay
  very deep, moderately well drained soil
- 109 – Capay clay, hardpan substratum
  deep, moderately well drained soil
- 112 – Clear Lake clay
  very deep; poorly drained under natural conditions, improved drainage with open ditches and flood control structures
- 114 – Clear Lake clay, hardpan substratum
  poorly drained under natural conditions; improved drainage with open ditches and flood control structures
- 117 – Columbia fine sandy loam
  deep, somewhat poorly drained soil
- 141 – Marcum clay loam, siltstone substratum
  deep, moderately well-drained
- 144 – Nueva loam
  very deep, somewhat poorly drained

Other soils:

- 129 – Galt clay
  moderately deep, moderately well-drained soil
- 137 – Jacktone Clay
  poorly drained under natural conditions; improved drainage with open ditches and flood control structures
- 158 – San Joaquin sandy loam
  moderately deep, well-drained soil
- 160 – San Joaquin Arents – Durochrepts complex (30x sandy loam)
- 175 – Yuvas loam
  moderately deep, moderately well-drained

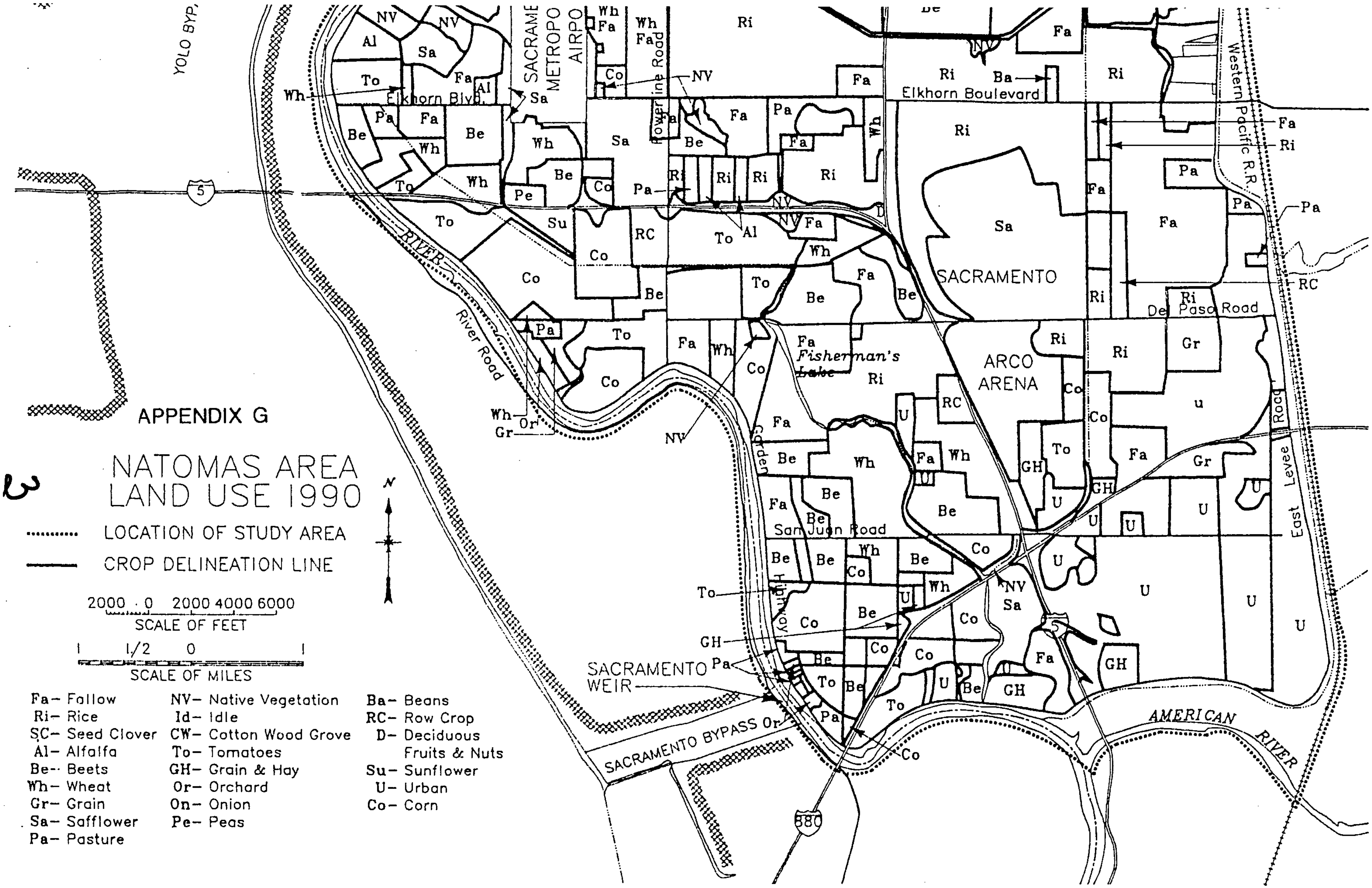
CROPS


West Catlett Road
Garden
FEATHER
Highway
RIVER
Howsley Road
Cross Canal
Western Pacific
Railroad
Sacramento Northern Railroad (Abandoned)
Natomas East Main Drain
Sankey Road
Pacific Avenue
Riego Road
Powerline Road
SUTTER COUNTY
PLACER COUNTY
SUTTER COUNTY
SACRAMENTO COUNTY
SUTTER COUNTY
YOLO COUNTY
FREMONT WEIR
70
99


FREMONT WEIR
YOLO BYPASS
SUTTER
COUNTY
SACRAMENTO
COUNTY
Riego Road
East Main Drain
Northern Railroad (Abandoned)
Western Pacific R.R.
Elverta Road
Elkhorn Boulevard
Elkhorn Blvd.
Power line Road
SACRAMENTO METROPOLITAN AIRPORT
SACRAMENTO RIVER
River Road
SACRAMENTO
Del Paso Road
ARCO ARENA
Fisherman's Lake
Garden Hwy
San Juan Road
East Levee Road
70
99
5
APPENDIX G
NATOMAS AREA
LAND USE 1990
LOCATION OF STUDY AREA
CROP DELINEATION LINE
N
2

APPENDIX G

NATOMAS AREA LAND USE 1990



3

Fa– Fallow
Ri– Rice
SC– Seed Clover
Al– Alfalfa
Be– Beets
Wh– Wheat
Gr– Grain
Sa– Safflower
Pa– Pasture
NV– Native Vegetation
Id– Idle
CW– Cotton Wood Grove
To– Tomatoes
GH– Grain & Hay
Or– Orchard
On– Onion
Pe– Peas
Ba– Beans
RC– Row Crop
D– Deciduous Fruits & Nuts
Su– Sunflower
U– Urban
Co– Corn

APPENDIX
H

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT OFFICE
SACRAMENTO, CALIFORNIA

DRAFT
HABITAT EVALUATION PROCEDURE
AMERICAN RIVER WATERSHED PROJECT
NATOMAS AREA
SACRAMENTO COUNTY, CALIFORNIA

by

Jini Scammell-Tinling
Fish and Wildlife Biologist

February 1991

DISCLAIMER

This is the completed draft Habitat Evaluation Procedures report for the Corps of Engineers American River Watershed Investigation, Natomas Area. It has been approved by the U. S. Fish and Wildlife Service. It does not necessarily represent official positions or approval of cooperating agencies, and it does not necessarily represent the views of all individuals involved in the process. This analysis is subject to modifications as dictated by new findings and changes in project designs or underlying assumptions.

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LIST OF FIGURES

PURPOSE OF REPORT

The results of the Habitat Evaluation Procedures analysis of the proposed Natomas area flood control measures of the American River Watershed Investigation are presented in this report. The study was conducted using a team of biologists and environmental professionals from the U.S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Water Resources, and U.S. Army Corps of Engineers. A team approach was used to design and conduct the study. The team discussed and/or made decisions regarding study goals, evaluation elements, field sampling sites, study assumptions, and mitigation goals, management actions, and compensation plans.

This report is a technical evaluation; and, therefore, intended for an audience with a thorough understanding of Habitat Evaluation Procedures. The results of this evaluation are intended for use of the participating agencies. The goal of the analysis is to describe the impacts of the proposed project and to determine the amount of mitigation necessary to compensate for those impacts.

PURPOSE OF THE STUDY

The objectives in this HEP study are to provide an assessment of the environmental impacts of two alternative measures designed to provide 200-year and 400-year level of flood protection for Sacramento, respectively. The objectives are as follows:

1. Determine baseline habitat conditions for selected evaluation elements in the project impact and potential mitigation areas.

2. Qualitatively and quantitatively assess project impacts on fish and wildlife habitat from an ecological perspective.

3. Determine mitigation alternatives for avoidable and unavoidable impacts.

4. Develop appropriate mitigation plans for Natomas impact areas.

5. Determine acreage needed to fully compensate for project induced impacts.

INTRODUCTION

The U.S. Army Corps of Engineers American River Watershed Investigation is directed at resolving flood protection problems in the Sacramento metropolitan area. To that end, they are examining flood control features in three geographic areas: American River canyon at Auburn, Lower American River between Folsom Dam and the Sacramento River, and the Natomas area.

For purposes of our analysis, we divided the Corps of Engineers' American River Watershed Project into these three areas, the Natomas area in Sacramento, Yolo, and Sutter Counties, the lower American River area within Sacramento County, and the Auburn area in Placer and El Dorado Counties. This report deals only with the Natomas area of the project. The Natomas area is the northwest corner of Sacramento County. The proposed project involves flood control enhancements and features which would provide this 53,000 acre low lying area with 200- or 400-Year flood protection. The Natomas portion of the American River Watershed Project is roughly bounded by the American River on the south, the Natomas Cross Canal on the north, the East Main Drain on the east, and the Sacramento River on the west. Additional work is planned for Dry and Arcade Creeks, Sacramento County, and the Fremont Weir on the Sacramento River at the head of the Yolo Bypass in Yolo County.

Two alternatives have been proposed for the Natomas area. Each alternative would provide different levels of flood protection to the entire area. Project design includes increasing existing levee elevations, widening of levees,

Table 1. Net changes in upland and wetland acreages under With- and Without-Project scenarios for Natomas portion of American River Watershed Investigation.

	ACREAGES		
		At End of Project Life	
	Present	W/O[1]	W/P
Wetlands	1,405	845	69
Uplands	40,456	24,508	2,365
	41,861	25,353	2,434

1 W/O - Without-Project
W/P - With-Project

changes in toe-drain locations, and construction of new levees in certain areas. New levees would be constructed along Dry Creek. A gated pump structure would be installed on the Natomas East Main Drain Canal just north of Dry Creek. Bridges would be raised or replaced on Dry and Arcade Creeks. In addition to levee work, the Fremont Weir and the northern eight miles of the Yolo Bypass would be widened 1,000 feet to divert additional flood waters into the bypass. Net acreage losses to these activities would be 22,919 acres, of which 776 acres is natural wetlands (Table 1). Because the affected acreages under the 400-Year protection alternative differed by less than one acre from the 200-Year plan, only a single analysis was conducted.

STUDY AREA

Impact Area

The approximately 53,000 acres of the Natomas area is a mosaic of agricultural, natural, and developed areas (Figure 1). Agriculture, currently, is the largest land use category. Developed areas are restricted to the

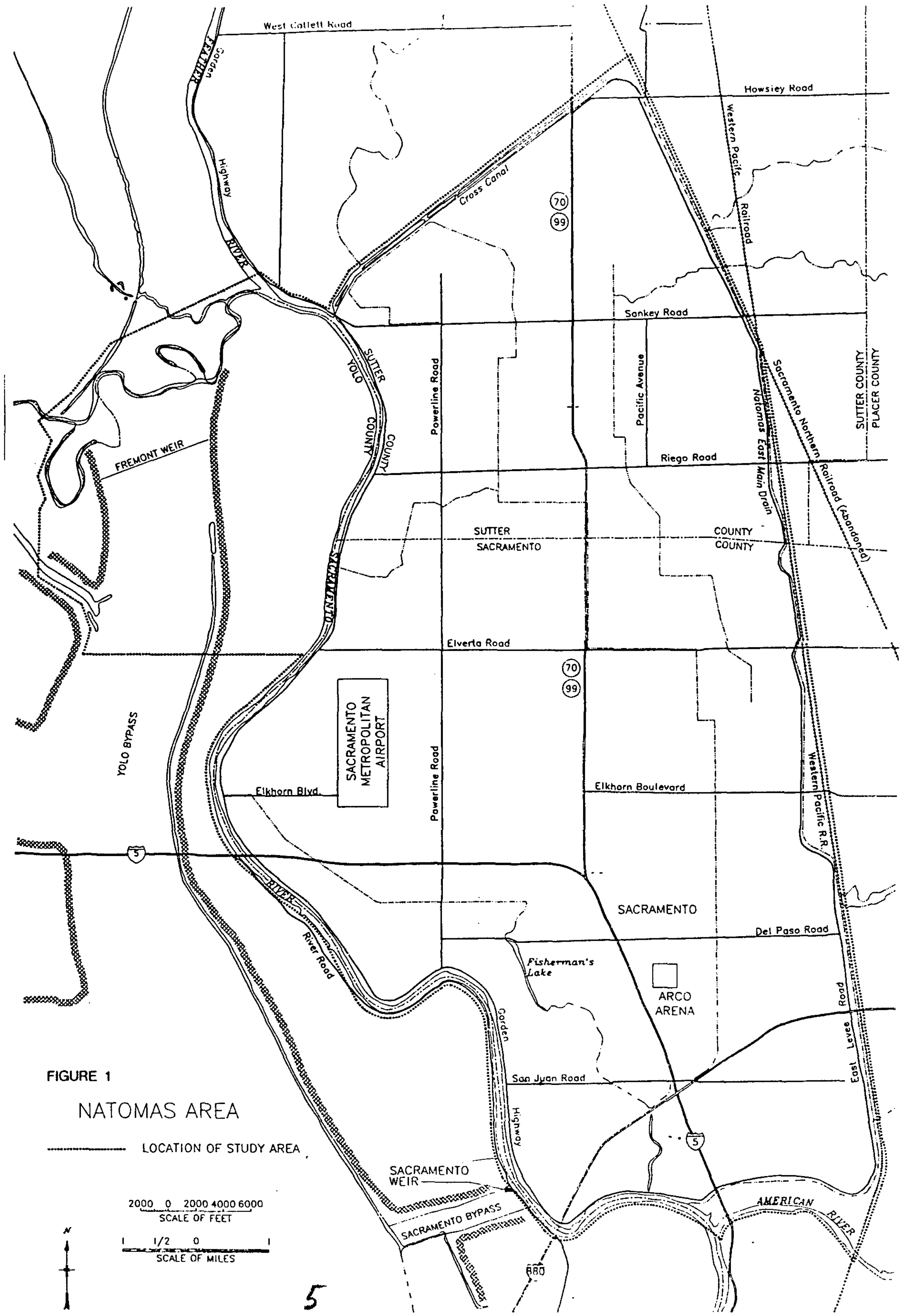


FIGURE 1

NATOMAS AREA

LOCATION OF STUDY AREA

2000 0 2000 4000 6000
SCALE OF FEET

1 1/2 0 1
SCALE OF MILES

N

5

southern basin with the exception of the Metropolitan airport complex. Natural areas exist primarily along water ways (e.g., drainage ditches, irrigation canals) and in reverted "old fields." The area, prior to construction of existing levees was a natural overflow area at the confluence of the Sacramento and American Rivers. The substaniating report details the location and nature of flood control features.

Mitigation Area

The proposed compensation area is located in the northern most portion of the Natomas basin. It is roughly delineated by the Cross Canal on the north, the East Main Drain on the east, Sankey Road on the south and the Sacramento River on the west. Currently, the area is under cultivation for rice, other grains, row crops, and irrigated pastures; some grasslands are also present.

The Natomas area was a natural historic overflow floodplain, therefore, its hydric soils are conducive to wetland restoration. The presence in this area of heritage oaks gives credence to the potential for savanna/grassland oak woodland restoration. Project induced losses in agricultural habitat types can be offset by management of certain crop types to benefit wildlife. Conversion and management of the area to a wetland, upland and agricultural complex would be accomplished through contouring, planting, flooding and burning.

METHODOLOGY

Habitat Evaluation Procedures (HEP)

HEP was used to quantify (1) baseline wildlife habitat values throughout the study area, (2) impacts from the proposed project, and (3) gains in habitat values on the mitigation areas with management. Impacts were determined for construction of project facilities such as levees, and project-induced accelerated development of the flood plain.

General HEP Principles. HEP is a habitat-based evaluation methodology developed for use in impact assessment and mitigation planning. The method is based on the assumption that habitat quality and quantity can be numerically described in terms of habitat units. HEP uses evaluation species or species life history elements in a species-habitat approach to impact assessment, and habitat quality for a given evaluation species is determined through use of a Habitat Suitability Index (HSI) model. Habitat types are delineated for the study area, and evaluation species are selected for the habitat types. HSI values quantify the value of the habitat types to the evaluation species. The HSI value multiplied by acres of a habitat type equals Habitat Units (HU), and HU's are the numerical basis of the HEP analysis.

Impact assessments are performed by quantifying HSI values at several points in time over the life of the project. These points in time are known as

"Target Years," and they are selected for years in which changes in habitat conditions can be reasonably defined. In every HEP analysis, there must be a Target Year 0 (TY0), which represents the baseline conditions, Target Year 1 (TY1), which is the first year habitat conditions are expected to deviate from baseline conditions, and an ending Target Year, which defines the life of the project. For this analysis, the life of the project is 100 years which ends at Target Year 102 (TY 102).

Evaluation species' HSI's and habitat acreages are required for all Target Years, HSI's and acreages are predicted for Target Years in which a change in value or area is expected to occur other than Target Year 0 (TY0). Acreages at TY0 are termed "baseline" and are quantified through use of aerial photographs and/or vegetation maps. Impact assessment is conducted by annualizing the habitat conditions and impacts over the life of the project by comparing HU's from two secnarios. These scenarios are (1) Future-With-Project and (2) Future-Without-Project. For each scenario, HU's are determined for each Target Year, and the HU's are averaged over the life of the project in an annualization process. Impact assessments are calculated using the annualized average HU's. These average HU's are known as Average Annual Habitat Units (AAHU), and the net impact of a proposed project is calculated by subtracting the Future-Without-Project AAHU's from Future-With-Project AAHU's ($AAHU_{with} - AAHU_{without}$). This process is performed for impact assessment on project lands and management actions on mitigation lands because both are in essence a "project."

Table 2. Thomas' (1979) life form categories and descriptors.

Guild Number	Breeds	Feeds
1	In Water	In Water
2	In Water	Ground, bushes, trees, water
3	On Ground around water	Ground, bushes, trees, water
4	On Ground	On Ground
5	On Ground	Bushes, trees or air
6	In Bushes	Ground, water or air
7	Bushes	Trees, bushes, air
8	Deciduous trees	Trees, bushes, air
9	Deciduous trees	On Ground
10	On very thick branches	On Ground or in Water
11	Own or natural cavity	Trees, bushes, ground, air
12	Other excav/nat cavity	Ground, water or Air
13	Underground burrow	On ground or under it
14	Underground burrow	Air or water

Evaluation Species. Evaluation species are the basis of HEP analyses, and they were selected for this study based on several criteria. Evaluation species were selected for specific wildlife guilds (Table 2) within given habitat types in an effort to represent the significant biological and environmental attributes of the project area and mitigation areas. Table 3 lists the evaluation species, the habitat types they were selected to represent their respective guilds.

The criteria considered in selecting the evaluation species for this study were:

1. The species must have a relatively high probability of occurring in the study area.

2. The species will likely be negatively impacted by the project.

Table 3. Evaluation species models used in Natomas HEP and the habitat types in which they were applied, and the guild category to which each belongs.

Model Name	UTSD	ROW	PFO	PEM	PSS	UG	AO	GRAIN	RICE	PAST	GUILD
					Habitat Type[1]						
GREAT BLUE HERON			1[2]	1	1				1	1	10
MUSKRAT (herbaceous wetlands)			2	2	2						14
RED-WINGED BLACKBIRD (upland)		4					4			4	6
WOOD DUCK (year-round)			8	8	8						12
YELLOW WARBLER			9								7
BLACK-SHOULDERED KITE			10		10						9
GRAY SQUIRREL (revised)	11		11								8
DOWNY WOODPECKER			12								11
WESTERN FLYCATCHER			14								8
SORA				15							3
RED-LEGGED FROG			16	16							1
CALIFORNIA VOLE						17					13
MALLARD - WINTERING								19			3
AMERICAN KESTREL							20				9
SHORT-EARED OWL	27					21		27			5
NORTHERN ORIOLE			22								8
MINK (for. & shr. wetl. <405)			23	23	23						13
RING-NECKED PHEASANT (Breed)		28				28		28			4
CALIFORNIA QUAIL											4
ACORN WOODPECKER	18										11
	UTSD	ROW	PFO	PEM	PSS	UG	AO	GRAIN	RICE	PAST	GUILD

[1] Habitat type abbreviations

ROW - agricultural row crops, e.g., sugar beets, carrots, etc.
UTSD - oak woodland
PFO - palustrine forest & riverine
PEM - palustrine emergent
PSS - palustrine scrub shrub
UG - grasslands
AO - agricultural orchards
GRAIN - grain crops, e.g., wheat, corn, etc (excluding rice)
RICE - rice
PAST - irrigated pasture, e.g., clover, alfalfa

[2] - Model Number in Natomas.HLB Micro-HSI Library

3. Sufficient data must be available to assign with some degree of confidence a relationship between the HSI model, habitat quality, and some measure of a species' response (i.e., biomass, density, reproductive success, etc.).

4. The baseline habitat conditions at the study site are indicative of the habitat conditions for the evaluation species.

5. Each evaluation species utilizes the habitat type(s) they were selected to represent.

6. The species occupies an ecological niche that represents significant environmental values in the study area.

7. The species has the potential to respond to management activities in the potential mitigation areas.

8. The species is not able to adapt well to alternate habitat types.

9. A model has been constructed for the species and is complete and/or published.

10. The model is suitable for this project, requiring little or no major modification.

Wildlife species lists for the Natomas Area were developed from a variety of sources, including the California Wildlife Habitat Relationships System. These lists were used to develop the species guild matrices and select the evaluation species using the above criteria. These lists are not included in this report in an effort to reduce the size of the document, however, this information is on file with the Sacramento Field Office of Fish and Wildlife Enhancement, U.S. Fish and Wildlife Service.

Habitat Suitability Index Models. HSI models were used for each evaluation species. These included HSI models published by the Service's National Ecology Research Center and unpublished HSI models developed by environmental consultants, the Soil Conservation Service and the Sacramento Field Office. Some of the selected models were modified and used successfully in previous HEP studies, e.g., yellow warbler from the Bureau of Reclamation's San Joaquin Conveyance Study. These models were modified by the HEP team as necessary. Each HSI model had its own assumptions which affected the HEP study design and analysis. These assumptions usually included geographic area applicablility, minimum habitat size, and cover type applicablility. The HSI models used in the study are included in Appendix H-1.

HEP Methods Employed for the Study. Habitat values for the evaluation species were determined from field sampling and study area site map interpretation. Suitability indices for the evaluation species were calculated by averaging the field data from sample points throughout the entire study area, and a single baseline Habitat Suitability Index value for each evaluation species was calculated for the study area using Micro-HSI (Version 2.1) software. Since the compensation area is within project lands, data gathered in the appropriate habitat types were used to develop baseline HSI value for the mitigation area.

The HEP accounting software (Version 2.1) was used to calculate the AAHU's for the Future-With-Project and for the Future-Without Project scenarios. The results of this analysis are presented as the HEP Form C's and these forms are

not included in the report to reduce document size. HEP software was used to determine the net change in AAHU's (Form D) between the Future-With-Project and Future-Without-Project scenarios. Comparison of net changes in AAHU's from project activities with net changes from proposed management activities yield HEP Form H's and the area required to compensate for project-induced losses. These forms are incorporated into the RESULTS AND DISCUSSION section.

Impact Assessment

Table 4. Description of the habitat types used in the Natomas HEP.

Habitat Type[1]	Crops Included
Orchard	Decidous fruits, nuts, almonds, walnuts, pears
Pasture	Mixed pasture, native pasture
Rice	Rice
Row Crop	Truck berry, onions, garlic, tomatoes, misc. truck crop, asparagus, melon, field crop, beans, misc. field, safflower, sugar beet, corn
Grain	Grain sorghum, grain/hay, barley, wheat, oats, misc. grain
PFO	Riparian vegetation (trees)
PEM	Riparian vegetation (marsh)
Grassland	Native vegetation, idle, not tilled
PSS	Medium brush
Oak Savanna	Oaks and grasslands
Open Water	Open water areas

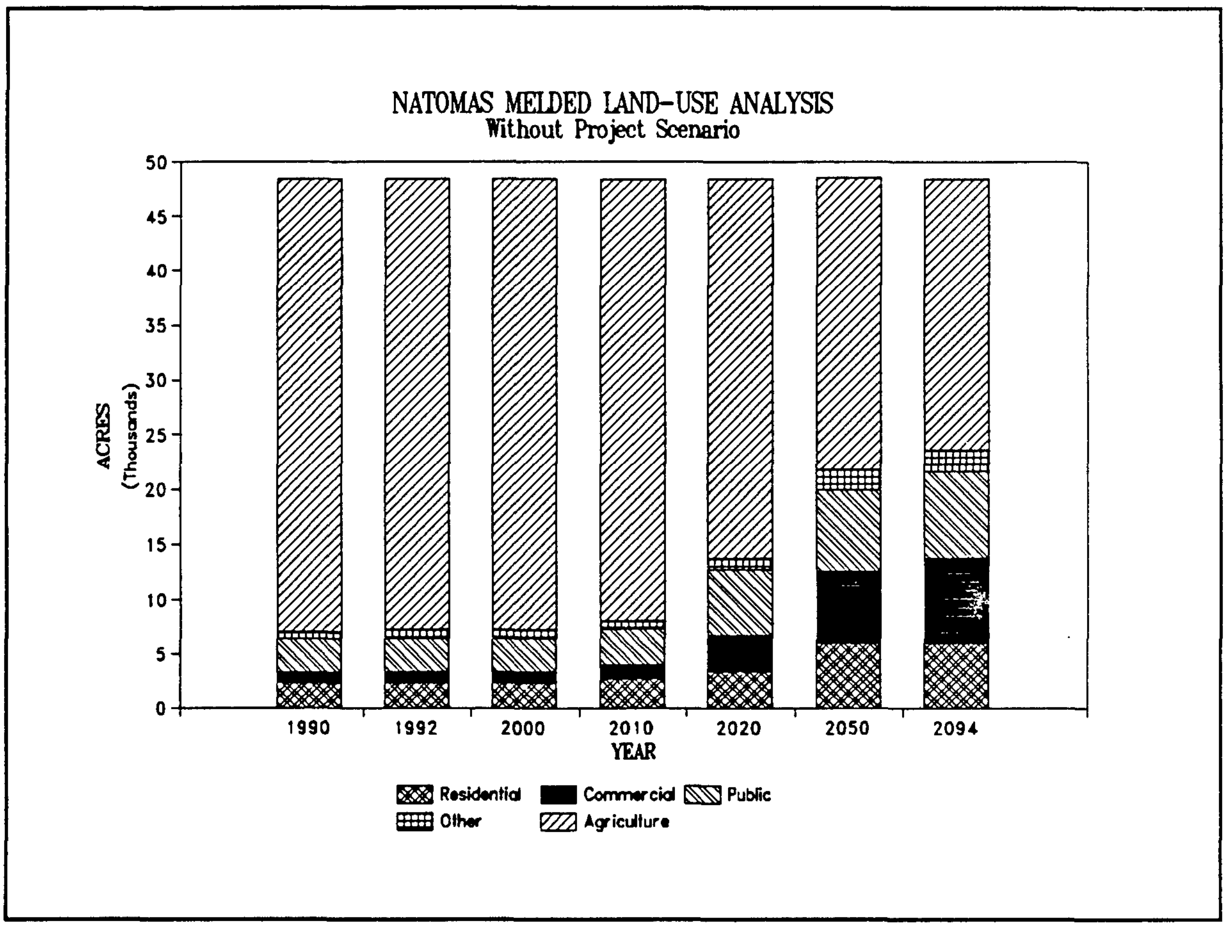
1 - some habitat types have been included or excluded from different iterations of the analysis based on changes in project design.

The direct and indirect impacts to terrestrial and aquatic wildlife resources were quantified using HEP. Direct losses in wildlife habitats from the project were determined from aerial bluelines (1:4800 scale) which combined project features (as provided by the Corps) and habitat types (as determined by field surveys). Indirect impacts were determined from 1984 California Department of Water Resources (DWR) land-use maps provided to the Service by the Army Corps of Engineers (Figure 2). Crop types used by DWR were more detailed than required by the HEP analysis. Appropriate crop type acreages were

Figure 2. Natomas basin crop types map. (Source: California Department of Water Resources).

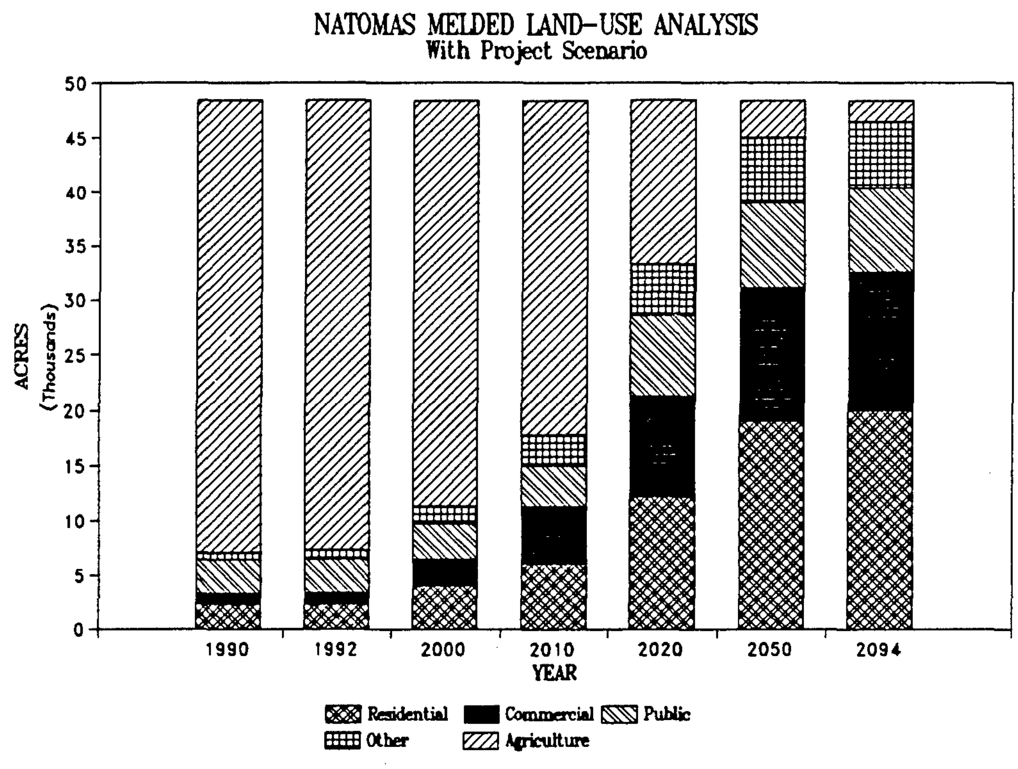
consolidated to conform to the HEP habitat types (Table 4).

Figure 3. Changes in Natomas land-use categories from 1990 - 2094 without implementation of a federal flood control project.



Indirect losses in wildlife habitats were based upon a land-use analysis which combined the Corps' September 11, 1990 analysis for the period from the start of construction to 2010, and the Corps' May 1990 analysis for the period 2010 to the end of the project life, referred to here as the "melded" land-use analysis. Figures 3 and 4 illustrate the land-use changes anticipated using the "melded" land-use analysis. Neither of these analyses identified wildlife habitats other than agriculture as a whole; therefore, to track changes in

Figure 4. Changes in Natomas land-use categories with implementation of the 200- or 400-Year flood control alternatives.



non-agricultural habitats, and based on the knowledge that most of these non-agriculture habitats, i.e., wildlands, are scattered among the agricultural lands, we assumed the percent losses to agricultural acreages would be paralleled by the same percent losses to other wildlife habitats, i.e., wildlands. For example, if agricultural acreages were reduced by 10 percent, wildlands were reduced by 10 percent. In addition, that 10 percent loss was allocated to each habitat type according to its percentage of the whole. This was necessary because the land-use data provided does not document how the changes translate to changes in the land-use maps, i.e., how development moves through the basin.

Table 5. Changes in Natomas habitat acres under the Without-Project scenario for the 200- and 400-Year flood control alternatives.

HABITAT TYPE	TARGET YEARS O	1	9	19	29	59	102
PEM	759.73	757.53	757.53	738.47	638.62	490.53	457.18
PFO	12.29	12.25	12.25	11.95	10.33	7.93	2.49
PSS	633.13	631.29	631.29	615.38	532.03	408.41	380.56
RICE	12,935.88	12,898.37	12,898.37	12,573.27	10,870.24	8,344.46	7,775.53
GRAIN	10,685.06	10,654.99	10,654.99	10,394.34	9,028.92	7,003.85	6,547.71
PASTURE	1,139.26	1,135.97	1,135.97	1,107.42	957.89	736.12	686.17
GRASS	2,927.75	2,919.42	2,919.42	2,847.22	2,469.03	1,908.13	1,781.79
ORCHARD	1,140.45	1,137.45	1,137.45	1,111.46	975.32	773.39	727.91
ROW	11,627.71	11,593.99	11,593.99	11,301.77	9,770.96	7,500.60	6,989.21
TOTAL	41,861.26	41,741.26	41,741.26	40,701.27	35,253.33	27,173.42	25,348.54

Table 6. Changes in Natomas habitat acres under the With-Project scenario for the 200- and 400-Year flood protection alternatives.

HABITAT TYPE	TARGET YEARS 0	1	2	9	19	29	59	102
PEM	759.73	756.23	748.34	681.05	562.82	278.47	63.67	37.65
PFO	12.29	12.25	12.13	11.0	49.12	4.52	1.04	0.61
PSS	633.13	631.29	624.71	568.53	469.84	232.46	53.15	31.43
RICE	12,935.88	12,898.37	12,734.41	11,586.71	9,570.15	4,720.21	1,056.58	612.69
GRAIN	10,685.06	10,341.39	10,209.94	9,289.76	7,672.96	3,784.47	847.12	491.23
PASTURE	1,139.26	1,132.52	1,118.12	1,017.38	840.29	414.45	92.77	53.80
GRASS	2,927.75	2,864.35	3,299.20	3,044.33	2,596.51	1,519.48	705.89	607.32
ORCHARD	1,140.45	1,031.16	1,018.06	926.30	765.09	377.36	84.47	48.98
ROW	11,627.71	11,593.99	11,446.61	10,414.98	8,602.35	4,242.87	949.73	550.73
TOTAL	41,861.26	41,261.55	41,211.51	37,540.05	31,089.12	15,574.29	3,854.42	2,434.44

Target Years for the impact analysis were selected based upon on the time frames given in the land-use analyses and the Corps information on project

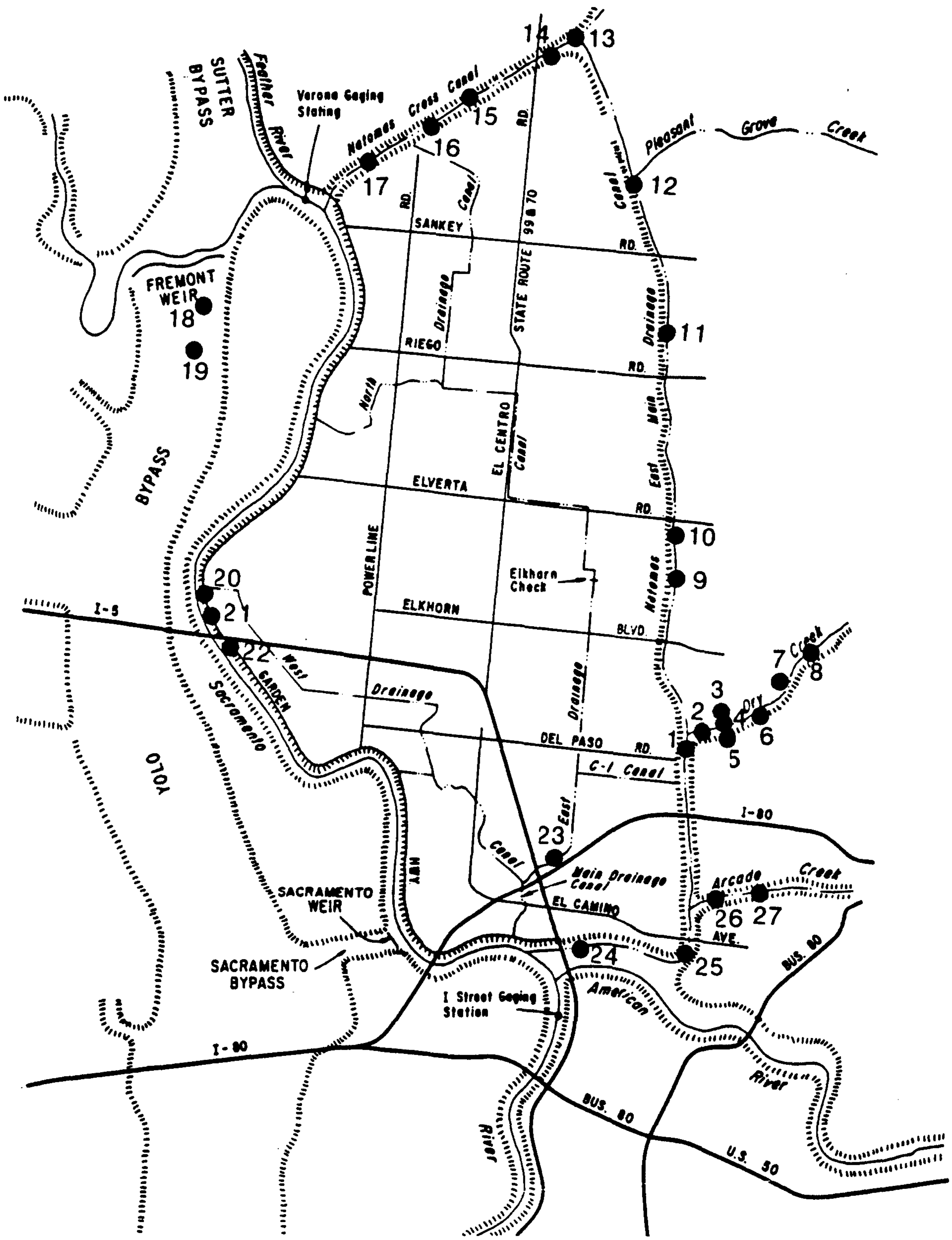
construction time. Changes in habitat acres for With- and Without-Project scenarios are presented in Tables 5 and 6, respectively.

Changes in habitat quality resulting from urban expansion were not addressed given the form of the land-use analysis, the dearth of information on an "urban zone of influence" on adjacent wildlands and time constraints. If information on this affect was available, project impacts would probably be greater than the current analysis predicts.

Wetland habitat acres were delineated from aerial maps, ground surveys and the assumption that the average drainage canal in the area is _____ feet wide. Open water areas were tracked separately, but recombined with the three wetland habitat types according to their percentage of the total wetland acres in the palustrine category, e.g., if PFO was 10% of all palustrine areas, 10% of the open water acres were added to the PFO category.

Wetland acres considered in this analysis included wetlands covered under Section 404 of the Clean Water Act, so called "jurisdictional wetlands". These areas were included because (1) not all activities which would eliminate a jurisdictional wetland are covered by Section 404, (2) it is impossible to determine which jurisdictional wetlands would or would not receive permits, (3) depending on property lines a jurisdictional wetland recognized as such today might be subdivided and extracted from that category based on size at some future date, and (4) although some duplicate mitigation might occur, land-use information does not exist to determine when and if potential jurisdictional wetlands would be developed.

Figure 5 - HEP Sampling Sites for Natomas Sub-area of American River Watershed Project, Sacramento County, California



Sampling Procedures

Table 7. Criteria used in selection of sampling sites for the Natomas Habitat Evaluation Procedures analysis.

SAMPLING SITE SELECTION CRITERIA
1. Reaches were defined as general areas of homogeneity in terms of habitat types and quality of habitat.
2. Adequate number of sample sites and transects were chosen so the data collected adequately represents the values within the habitat types.
3. Sites were selected for their suitable access, i.e., landowner can be readily identified to gain permission for access.
4. Sites were identified in which data collection could be implemented.
5. Sites were chosen that were representative of direct and indirect project impacts.
6. The number of sites selected was directly related to habitat type acreages impacted.

Field sampling was extensively and carefully designed. A stratified field sampling scheme was designed to include all the variability in habitat quality. Stratification was by habitat type and general habitat quality and sample areas were selected within each habitat. A random number table was used to select the sample points within the selected sample area. The minimum size of a sample plot was 0.1 hectares for wetland habitats and 50-meter transects for other habitat types.

Measurement of Habitat Variables

Sampling was conducted for seven to forty-five different habitat variables per habitat type, and the following section describes the general habitat sampling methodology. Appendix H-2 contains a copy of the field data sheet used in the study, and a more detailed description of the sampling protocol is presented with the Auburn Area HEP report.

Terrestrial Wildlife Habitat Variables. Habitat sampling was conducted from April to May 1989. The majority of habitat measurements were made on 0.1 hectare areas consisting of a 50-meter line transect and contiguous 20-meter belt transect. In riparian woodlands, line transects were placed perpendicular to water flow. Topographic maps were used to locate the transects on the ground.

Random numbers were used to select a position for a 50-meter line transect. Along the transect, the line intercept method was used to measure variables such as average size of ground cover objects and percent cover of various habitat parameters and herbaceous canopy height. Belt transects, 20-meters wide on a randomly selected side of the transect, were used to establish densities variable values e.g., number of nest sites per hectare and average values for shrub and tree canopy height.

Distance variables were measured in the field or from topographic maps and aerial photographs. Maps and photographs were used when the field crew was unable to locate the parameter or the distance was beyond line of sight. These variables measured in the field included distance to water, escape cover, or feeding areas. Variables most often measured from maps or photographs included distance to nesting areas or foraging areas or distance from human activity.

Data Gaps. Data gaps and problems occurred for various reasons: (1) gaps occurred when required information was not collected in the field; (2) they also occurred in one instance as an oversight in field data form development,

i.e., a single variable for a single model was accidentally excluded; (3) problems in the data occurred when sampling protocols were not followed.

Problems of the first type were dealt with by either excluding that sample site from the average for that variable value, or if it occurred in a habitat type sampled only once, the optimum value for that variable was assigned to it. An optimum value was also assigned to the value of the variable accidentally left off field data forms. These artificial values were maintained throughout the analysis to provide consistency and reduce bias.

Deviations from the sampling protocol were a challenge. The most difficult one to deal with was when a true point-intercept method of recording the first thing touched by the sampling pin was abandoned for recording each and every forb and grass encountered by the sampling pin on it on the way to the ground. This was handled via a subjective evaluation of the available data and interpreting its value. This was done when no other data source was available.

HSI Determination

Average values for the habitat variables were calculated for each habitat type, and Habitat Suitability Index values were determined from the habitat variable averages for each habitat type using the Micro-HSI software.

Compensation plans were developed using the mitigation goal of no net loss of in-kind habitat value for all natural wetland habitat types. The mitigation

goal for agricultural land was no net loss of habitat value, and mitigation was developed with a goal of equal value. Special attention was given to rice because of its high wildlife value compared to other agricultural types.

Decisions regarding trade-offs were made for each agricultural habitat type. Trade-offs refer to the ability to trade Habitat Units for a given evaluation species among habitats. For example, loss of Habitat Units for the American kestrel in orchards could be compensated in a trade-off by mitigating with the appropriate amount of Habitat Units in palustrine forest. No trade-offs for the evaluation species were acceptable for palustrine habitats. Equal trade-offs for an evaluation species were acceptable between rice, orchard, grains, pasture and row crop and other agriculture or natural habitats.

Mitigation Planning

Compensation via acaquisition and management is necessary when the other mitigation actions, e.g., impact avoidance, modified project design, etc., leave all or a portion of project-induced impacts unmitigated. Although project design has been modified, unmitigated impacts remain, requiring some type of management/ mitigation action.

The northern Natomas basin was selected as a compensation site because 1) it is an undeveloped area, 2) it is bounded on three sides by natural barriers which would enhance wildlife values, 3) it is with the project area, 4) it has a permanent water source available, and 5) the soils are appropriate for recreation of wetlands.

A management plan (e.g., Future-With-Management) was developed for the mitigation area by the HEP team. The management actions and assumptions for the mitigation areas are presented in detail in the following section.

Table 8. Habitat types and baseline acreages of proposed Natomas mitigation area.

	HABITAT TYPES					
Area	Rice	Grain	Pasture	Row Crops	Grassland	Total
Area 1[1]	3,220.04	0	20.58	514.38	0	3,755.00
Area 2	1,577.60	897.94	81.50	553.96	0	3,111.00
Area 3	2,179.04	441.52	26.18	208.26	580.00	3,435.00
Area 4[1]	3,043.25	280.34	148.62	373.79	14.00	3,860.00
	10,019.93	1,619.80	276.88	1,650.39	594.00	14,181.00

[1] Areas used to conduct the analysis. All four areas would be needed to compensate project induced impacts.

Wetland habitats impacts could be mitigated by converting agricultural lands to a mosaic of palustrine systems, as typified by a portion of mitigation area 4 (Figure 6). Upland impacts, including rice, could be mitigated by recontouring and converting existing agricultural land to grassland/oak savannah and rice/pasture/grain fields. These "new" ag lands would be managed for wildlife. Existing habitat types would be converted to the "new" habitat types are outlined in Table 8.

Figure 6. Map of habitat types on the Natomas mitigation area with management.

ASSUMPTIONS

Several general assumptions are necessary for the proper use of HEP and HSI models, and assumptions for HEP are different than the assumptions regarding HSI models. For this study, general assumptions regarding HEP include:

1. HEP is a suitable methodology for quantifying project-induced impacts to wildlife habitats.

2. Quality and quantity of wildlife habitat can be numerically described using the indices derived from the HSI models and the associated Habitat Units.

3. The HEP analysis addressed direct and indirect impacts from project construction and operation in the study area.

General assumptions regarding the use of HSI models include:

1. HSI models are hypotheses based on available data.

2. HSI models are conceptual models and may not measure all ecological factors that affect the quality of a given habitat type for the evaluation species.

3. The HSI value for the evaluation species is a measure of habitat quality that is assumed to be related to carrying capacity or some other response measure for the evaluation species.

Impact Assessment

Assumptions regarding future land-use actions, management of mitigation areas, and project-induced impacts are needed to complete the HEP analysis. These assumptions are necessary for both impact assessment and mitigation planning, and there are Future-With-Project and Future-Without-Project scenarios for each. Table 9 presents the assumed changes in habitat types over the life of the project for the Future-Without-Project scenarios, and the changes in the baseline habitat for the area for the Future With Project. Table 10 shows changes in habitat types in the proposed mitigation area without management and changes in the same area with management.

Mitigation

Changes in habitat conditions for Future-Without and Future-With Management on the mitigation lands were developed (Table 12). These scenarios were based on various assumptions (Table 13).

Table 9. Predicted habitat changes for the Natomas area under Without- and With-Project scenarios.

Scenario/Target Year	Predicted Habitat Changes
Future Without Flood Control Project (No Habitat Management)	
Target Year 0	Baseline habitat conditions.
Target Year 1	Same as baseline
Target Year 19	Upland, agricultural and wetland habitats in the project area begin to convert to residential, commercial, industrial areas. Conversion of directly and indirectly impacted areas follows "melded" land-use analysis.
Target Year 51	Same as TY 19
Target Year 101	Same as TY 51
Future With Flood Control Project (No Habitat Management)	
Target Year 0	Baseline habitat conditions - site characterized by wetland, upland and agricultural habitats.
Target Year 1	Project construction begins; removal of wetland and upland vegetation begun and completed. Area of direct impact reverted to levee, floodway, concrete, or riprap habitat. Indirect impacts follow "melded" land-use analysis.
Target Year 9	Indirect impacts, i.e., flood protection, yield conversion of lands in all land-use categories to developed lands.
Target Year 19	Same as TY 9
Target Year 101	End of project life

Table 10. Assumptions used in predicting future conditions in Natomas area under Without- and With-Project scenarios.

Future Without Flood Control Project (No Habitat Management) Assumptions

1. Existing habitat types are:
   Project Area
   a. palustrine forest
   b. palustrine emergent
   c. palustrine scrub-shrub
   d. grasslands
   e. orchards
   f. grain
   g. pasture
   h. row crops
   i. rice
   k. oak woodland
   Compensation Area
   a. rice
   b. ruderal grasslands
   c. pasture
   d. row crops
   e. other grains
2. Goal of evaluation is to replace natural habitat values, thereby requiring that the system be modeled ecologically, rather than based on aesthetic or recreational values.
3. Rice is very important to Pacific Flyway birds using the Natomas basin.

The Future With Flood Control Project - (No Habitat Management)

1. All habitats within direct impact zone will be removed by construction activities.
2. Lacking information on maintenance practices for project levees, direct impacts were assumed permanent.
3. Project impacts were assumed not to diminish the quality of adjacent habitats.
4. Habitat suitability index values for the evaluation species will not change over the period of analysis.
5. Since land-use scenarios and acreages provided by the Corps do not include wildlands, we assumed wildland losses, i.e., indirect impacts, would parallel (based on percent losses) agricultural acreage losses. Percent losses were calculated from the "melded" land-use analysis.
6. The timetable of acreage losses would follow the "melded" land-use analyses.
7. Construction of the project will require 1 year for each segment worked on, i.e., no area will be directly impacted by construction for more than one year.

The Future Without Flood Control Project

1. Habitat types and land-uses will change as predicted by the "melded" land-use analysis under without project alternative, i.e., partial development and conversion of agricultural and wildlands to residential, commercial and industrial areas.
2. Habitat types created are:
   a. residential
   b. commercial
   c. industrial
   d. roads, etc.

Table 11. Predicted changes in Natomas mitigation areas under Without- and With-Management scenarios.

Scenario/Target Year	Predicted Habitat Changes
Future With Flood Control Project/ Without Habitat Management/Compensation Area	
Target Year 0	Baseline habitat conditions.
Target Year 1	Flood control project construction begins; agricultural use of mitigation area begins to phase out. Construction completed.
Target Year 9	Conversion of baseline agricultural habitat types proceeds at pace established in "melded" land-use analysis.
Target Year 101	Same as Target Year 9.
Future With Flood Control Project/ With Habitat Management/ Compensation Area	
Target Year 0	Baseline conditions. Site characterized by rice, other grains, row crops, pasture and grasslands.
Target Year 1	Site contoured for wetland, emergent vegetation planted, tree (cottonwoods, oaks) and shrub species (willow spp.) planted as shrubs. Water delivery system established and year-round water source secured, and applied. Oak savannah/grassland area site contoured, soil sterilization.
Target Year 2	Rice values regained to baseline and maintain throughout project life. Rice fields will be disced in the fall to replace burning. Pasture and grain areas regain and maintain baseline values. One-third of agriculture areas will be fallow, on average, as part of a rotational scheme.
Target Year 3	Hydroseeding of oak savanna/grassland area, native oaks planted.
Target Year 5	Grassland values regained.
Target Year 6	Palustrine vegetation maturing. Emergent marsh reaches full value to evaluation species. Scrub-shrub values increasing.
Target Year 11	Palustrine tree species achieve tree status, i.e., greater than 4 meters tall. Palustrine forested acreage finally present.
Target Year 21	Optimum snag density achieved in palustrine forested areas.
Target Year 34	Oak savannah/grassland burned to maintain open, native grasslands. Oaks old enough to withstand the burn. (Cycle repeated every 15 years.)
Target Year 36	Grassland values regained, and will continue to be two years after each burn event.
Target Year 51	Maximum palustrine forest values achieved.
Target Year 80	Oaks reached maximum value attainable for Natomas. Burn cycle of grasslands continues.
Target Year 101	Values remain generally the same, i.e., homeostasis. End of project life.

Table 12. Assumptions used in predicting future conditions in the proposed Natomas mitigation area under Without- and With-Management scenarios.

Future With Flood Control Project With
Habitat Management of the Compensation Area

1. Compensation area is an agriculture area comprised of rice, grains, row crops, pasture and ruderal grasslands.

2. 48% of the compensation area will be converted to lower, mid and upper terrace palustrine forest (0.5%), emergent (30%) and scrub-shrub (17.4%) habitat, and a permanent water supply. The remainder will be allocated to agriculture (19.5%), which will be divided equally among rice, grain and pasture, and oak savanna/grassland (33%).

3. Planting and contouring of the compensation area will begin in concert with the construction period for the flood control project.

4. Wetland compensation areas will be planted with trees such as Fremont cottonwoods, valley, interior live, blue and oracle oak, and shrubs such as sandbar, yellow, arroyo, red, Gooding's and dusky willow, elderberry, and vines such as blackberry and wild rose. Emergent vegetation will consist of *Typha* and *Scirpus* spp. All vegetation will be fertilized at planting and irrigated for 2-3 years until established. The density of plantings will be:
   oaks - 100/acre
   cottonwoods - 200/acre
   willows - 400/acre

   Native oak species will be planted in designated areas.

5. Generally an increase in percent canopy cover of herbaceous cover in first year. Density and value of emergent/submergent cover reaches maximum at Target Year 6. Temperature in littoral zone, high initially, with gradual cooling as emergent, shrub, and tree canopy increase.

6. No trees (i.e., woody vegetation > 4 meters) until TY 11. dbh increases with age. No average tree dbh until TY 11. Then dbh will increase approximately 1 - 2 inches per year. Tree density will also increase at TY 11 when shrubs become trees. A maximum density will be reached, and then some thinning will occur as competition eliminates some individuals (yielding snags).

7. Shrubs - start with one gallon stock (tree species) and willow whips. Minimal canopy cover initially. Maximum density at TY 11. Followed by decline as overstory trees shade out some shrubs.

8. Snags - optimum snag density achieved at TY 21, with constant density level thereafter.

9. Burning is an effective grassland management tool, and trees 35 years old and greater can withstand grassland trees used to manage weedy grass species.

10. Hydroseeding native grasses is effective if preceded with soil sterilization.

11. Rice is a very valuable habitat type to birds of the Pacific Flyway using the Natomas area.

12. Wetland and upland habitat types are acceptable mitigation for agricultural and other upland impacts.

Future Without Management of
Compensation Area

1. Agricultural lands will be converted to residential, industrial, or commercial developments in manner consistent with the melded land use analysis.

2. The land use analysis developed for this HEP application is a realistic representation of changes which will occur in the basin over the life of the

Table 13. Compensation/Mitigation goals and resource categories.

	COMPENSATION/MITIGATION PLANNING	
Resource Category	Habitat - Species	Goal
1	High value, unique on a national or ecoregion basis	No loss of existing habitat value
2	High value, relatively scarce or becoming scarce on a national or ecoregion basis	No net loss of in-kind habitat value
3	High to medium value and relatively abundant on a national basis	No net loss of habitat value
4	Medium to low value habitat	Minimize loss of value

Our mitigation goal is to assure that recommended compensation is consistent with the fish and wildlife values involved. Resources cover a range of habitat values from those considered to be unique and irreplaceable to those believed to be of low value to fish and wildlife resources (Table 13). Habitat types to be impacted by the Natomas portion of the American River Watershed project fall into two categories. Wetland habitat in the project area is considered to be of high value to wildlife and relatively scarce on a regional basis and therefore placed in Resource Category 2. The goal for this habitat type, therefore, is to prevent any net loss of in-kind habitat value. The goal for other habitat types to be affected by the flood control project (upland, agricultural lands and rice) is to minimize the loss of habitat value. For the purposes of this analysis, wetland and upland mitigation was considered acceptable as compensation for non-wetland and rice habitat losses.

Table 14. Compensation goal and replacement objectives.

Compensation Type	Species	Replacement
In-Kind	Same species	Equal for individual species
Equal	Same or different species	Equal for sum of all species
Relative	Same or different species	Equal for weighted sum of all species

Based on the above, the HEP analysis was divided into two sub analyses: (1) wetland habitat losses with the flood control project versus wetland habitat gains on the compensation areas, and (2) all other habitat losses and gains with the project versus upland and wetland habitat gains in the compensation area. The subdivision was made because of the resource categories into which the habitats were placed and the different compensation goals dictated by those categories. The wetland cover types were combined because of the Resource Category 2 designation requiring no net loss of in-kind habitat value. The upland habitat types were grouped because their Resource Category 3 and 4 designations permit trade-offs. Wetland habitats were accepted, in addition to upland habitats, as mitigation for upland impacts in recognition by the HEP team of the value of rice fields to wetland species, and the history of the Natomas area. In-kind mitigation in the HEP process requires using the compensation acreage for the species with the largest acreage requirement. The goal of the HEP team in this HEP application was to model the natural systems from an ecological perspective and to regain all the elements of that system in the mitigation. To accomplish this goal, each and

every evaluation element must be mitigated thus, mitigating using the species with the highest acreage requirement insures this goal. An equal compensation goal involves averaging project losses against management gains. The losses of one species can be offset by gains provided to one or more other species. In addition, this treatment of the data prevented trading off habitat losses for multi-cover evaluation species (i.e., species that occur in more than one habitat type) with gains in other less valuable wildlife habitat types. For example, losses in wetland habitat for the muskrat would not be offset or replaced by gains in floodway habitat.

Results of the HEP Analysis

Wetland Areas. Results of the field evaluation of the 200- and 400-Year flood protection alternatives under baseline conditions are shown in Table 15. HSI values for baseline conditions varied from 0.17 to 1.0 for wetland species in the project impact area. For all species combined, the average HSI value was approximately 0.58 for the existing palustrine emergent, forested and scrub-shrub in the area. This value indicates that the total available habitat within the project impact area is above average in its capacity to support the evaluation species.

Baseline conditions for the proposed mitigation/compensation areas are shown in Table 16. HSI values varied from 0 to 1.0 for habitats in the wetland compensation areas. For all species combined, the average HSI value was 0.21 in the proposed wetland compensation area. These values indicate that the

Table 15. Natomas Wetlands Form B. Baseline Habitat Suitability Index values and acres for wetland evaluation elements used in the HEP analysis of the Natomas 200- and 400-Year flood control alternatives.

Form B: Habitat Units
Study Name: NATOMAS - NOVEMBER 1990
Action: PA 1 (without project) Wetlands
Target Year: 0

Evaluation ID#	Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
1	Great Blue Heron	1405.10	1.00	1405.10
2	Muskrat	1405.10	0.17	238.87
4	Wood Duck	1405.10	0.24	337.22
5	Yellow Warbler	12.30	0.53	6.52
6	Blk-shouldered Kite	645.40	0.80	516.32
7	Gray Squirrel	12.30	0.45	5.53
8	Downy Woodpecker	12.30	0.50	6.15
9	Western Flycatcher	12.30	0.89	10.95
10	Sora	759.70	0.16	121.55
11	Red-legged Frog	1405.10	0.69	969.52
16	Northern Oriole	12.30	0.78	9.59
17	Mink	645.40	0.69	445.33

Table 16. Natomas Wetland Mitigation Form B. Baseline Habitat Suitability Index values and acres for wetland evaluation elements used in the HEP analysis of the Natomas 200- and 400-Year flood control alternatives.

Form B: Habitat Units
Study Name: NATOMAS - NOVEMBER 1990
Action: MP 1 (without project) Wetland mitigation w/o mgmt
Target Year: 0

Evaluation ID#	Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
1	Great Blue Heron	1528.83	1.00	1528.83
2	Muskrat	0.00	0.00	0.00
3	Red-winged Blackbird	251.56	0.10	25.16
4	Wood Duck	0.00	0.00	0.00
5	Yellow Warbler	0.00	0.00	0.00
6	Blk-shouldered Kite	0.00	0.00	0.00
7	Gray Squirrel	0.00	0.00	0.00
8	Downy Woodpecker	0.00	0.00	0.00
9	Western Flycatcher	0.00	0.00	0.00
10	Sora	0.00	0.00	0.00
11	Red-legged Frog	0.00	0.00	0.00
13	Mallard (wintering)	1519.97	0.95	1443.97
15	Short-eared Owl	251.56	0.81	203.76
16	Northern Oriole	0.00	0.00	0.00
17	Mink	0.00	0.00	0.00
18	Ring-necked Pheasant	242.70	0.50	121.35

total habitat within the compensation sites combined was well below average in its capability to support all the evaluation species.

Changes in wetland AAHU's with the flood control project alternatives are compared in Table 17 for the future with the flood control project (no habitat management) versus the future without the project. The total change in AAHU's is -1,790.70. This value indicates that construction of the flood control project without a compensation plan for wetland habitat losses would result in a net loss in habitat value for all evaluation species combined. Figure 8 graphically depicts the impacts of the project on wetland habitat units. Conversely, adoption of the scenario - the future with habitat management on the compensation areas versus the future without management of the compensation areas - would result in a net gain of 5,516.2 AAHU's with the wetland compensation plan (Table 18 and Figure 9).

Table 19 shows the in-kind compensation needed in acres for the 200-Year or 400-Year protection alternative. Adoption of this alternative would result in the loss of 776 acres of wetland habitat. Given the management scenario as outlined in the Assumptions section, 5,781.57 acres would be needed for compensation.

Table 17. Wetland Form D - Net change in wetland Average Annual Habitat Units (AAHU) with the 200- or 400-Year Natomas flood control alternatives.

Form D: Net Change in AAHU's Date: 11/26/1990
Study Name: NATOMAS - NOVEMBER 1990
Action: PA 2 (with project) Wetlands w/ Project
Compared To: PA 1 (without project) Wetlands
Period of analysis: 102

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	Great Blue Heron	440.08	1059.43	-619.35
2	Muskrat	74.81	180.10	-105.29
4	Wood Duck	105.62	254.26	-148.64
5	Yellow Warbler	2.03	4.37	-2.34
6	Blk-shouldered Kite	161.85	388.73	-226.87
7	Gray Squirrel	1.72	3.71	-1.98
8	Downy Woodpecker	1.92	4.12	-2.20
9	Western Flycatcher	3.41	7.33	-3.92
10	Sora	38.04	91.76	-53.72
11	Red-legged Frog	303.66	731.00	-427.35
16	Northern Oriole	2.99	6.43	-3.44
17	Mink	139.65	335.28	-195.62

Table 18. Wetland Mitigation Form D. Net change in wetland mitigation Average Annual Habitat Units (AAHU) with management of mitigation areas 1 & 4 for the Natomas 200- and 400-Year flood control alternatives.

Form D: Net Change in AAHU's
Study Name: NATOMAS - NOVEMBER 1990
Action: MP 2 (with project) Wetland Management
Compared To: MP 5 (without project) Mitig w/o Land Use
Period of analysis: 102

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	Great Blue Heron	1718.60	1157.62	560.98
2	Muskrat	865.14	0.00	865.14
3	Red-winged Blackbird	0.08	19.11	-19.03
4	Wood Duck	1653.81	0.00	1653.81
5	Yellow Warbler	10.24	0.00	10.24
6	Blk-shouldered Kite	470.45	0.00	470.45
7	Gray Squirrel	10.63	0.00	10.63
8	Downy Woodpecker	6.26	0.00	6.26
9	Western Flycatcher	13.15	0.00	13.15
10	Sora	977.85	0.00	977.85
11	Red-legged Frog	1651.14	0.00	1651.14
13	Mallard (wintering)	4.72	1092.74	-1088.02
15	Short-eared Owl	0.67	154.81	-154.14
16	Northern Oriole	12.77	0.00	12.77
17	Mink	636.47	0.00	636.47
18	Ring-necked Pheasant	0.40	91.87	-91.48

Figure 8. Changes wetland habitat unit over the period of analysis under Without- and With-Project scenarios. The area between the lines represents the values requiring compensation.

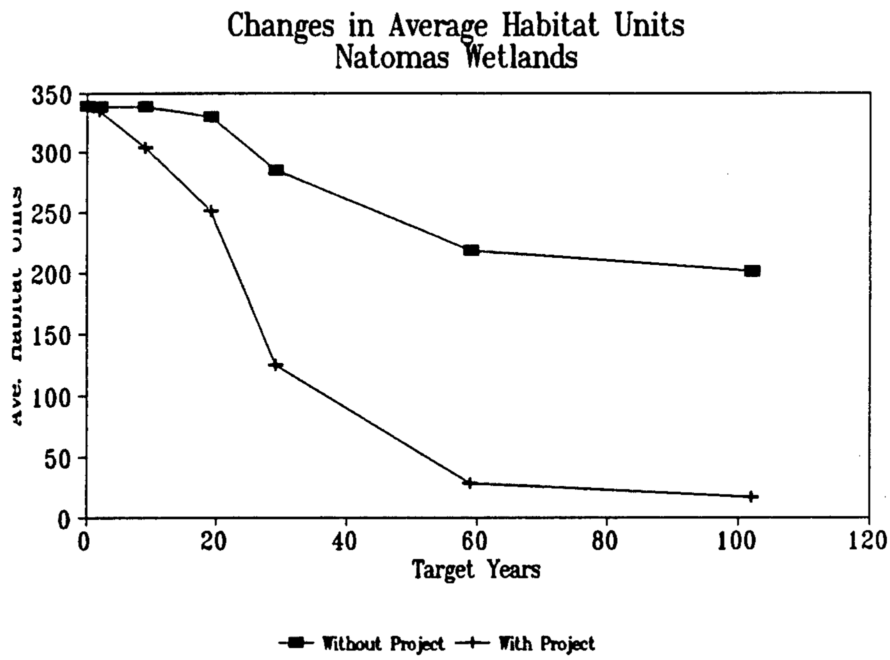


Figure 9. Wetland mitigation site - changes in habitat units over the period of analysis under Without- and With-Management scenarios. The area between the lines represents the habitat values gained through the proposed management actions.

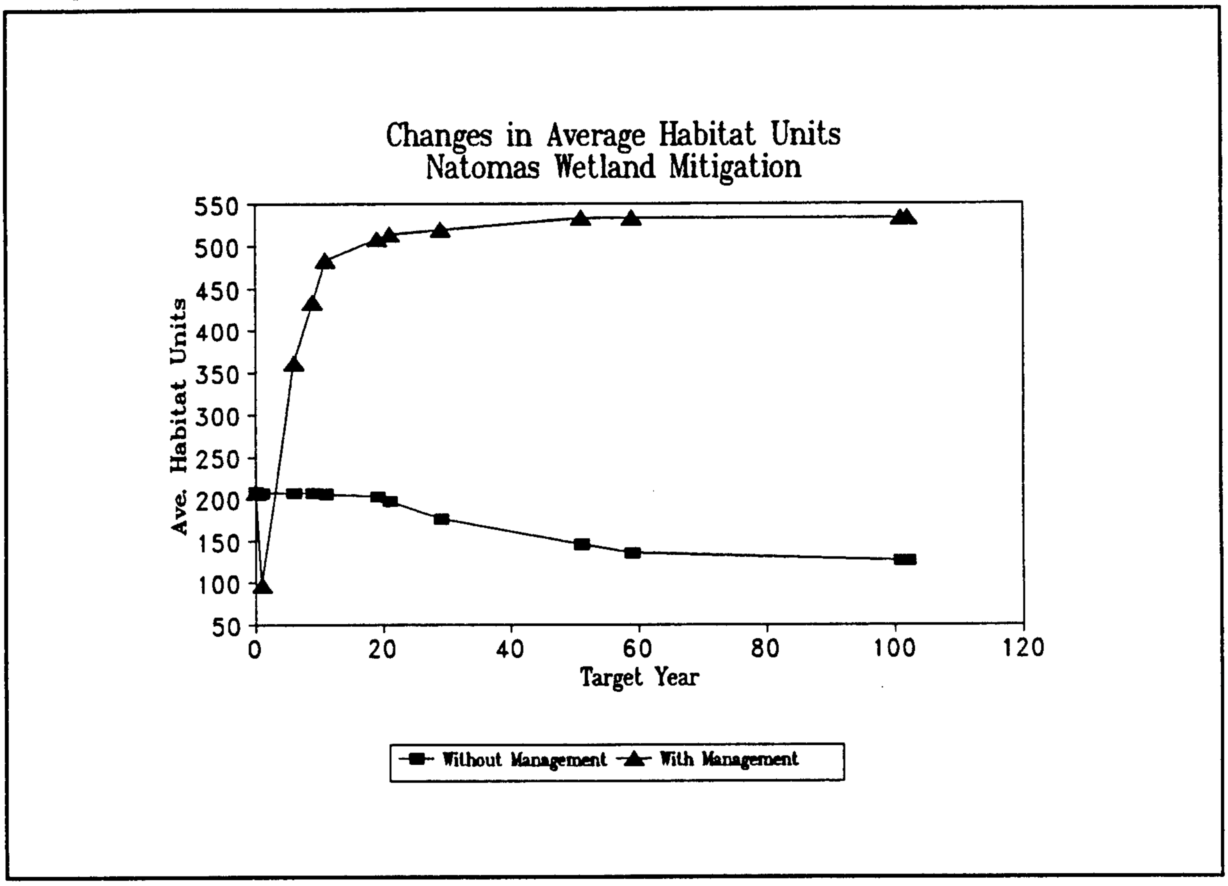


Table 19. Area needed for in-kind compensation of 200- and 400-Year flood control alternatives for the Natomas area wetlands.

Area Needed For In-Kind Compensation (Form H Results)   Date: 11/26/1990

Study Name: me		Alternative	Plan	Compensation
1	Great Blue Heron	-619.35	189.77	5781.57
2	Muskrat	-105.29	865.14	215.60
4	Wood Duck	-148.64	1653.81	159.22
5	Yellow Warbler	-2.34	10.24	404.30
6	Blk-shouldered Kite	-226.87	470.45	854.32
7	Gray Squirrel	-1.98	10.63	330.57
8	Downy Woodpecker	-2.20	6.26	623.19
9	Western Flycatcher	-3.92	13.15	528.26
10	Sora	-53.72	977.85	97.32
11	Red-legged Frog	-427.35	1651.14	458.51
16	Northern Oriole	-3.44	12.77	477.06
17	Mink	-195.62	636.47	544.49

Upland Areas. Results of the field evaluation of the upland habitat conditions are shown in Table 20. HSI values for baseline conditions varied from 0.09 to 1.0 for species in the project impact area. For all species combined, the average HSI value was approximately 0.74 for the existing upland habitat in this area. This value indicates that the total available habitat within the project impact area is above average in its capacity to support the evaluation species.

The baseline HSI value of the upland habitats in mitigation area 4 and the wetland habitats in area 1 averaged 0.43, indicating the area is generally below average in its ability to support the evaluation species (Table 21).

Changes in AAHU's with flood protection are compared in Table 22 for the future with the flood control project (no habitat management) versus the future without the project. The total change in AAHU's is -22,821.6. This value indicates that construction of the flood control project without a compensation plan for upland habitat losses would result in a net loss in habitat value for all evaluation species combined, and is graphically depicted in Figure 10. Conversely, adoption of the scenario - the future with habitat management on the compensation areas versus the future without management of the compensation areas - would result in a net gain of 11,198.4 AAHU's with the compensation plan (Table 23 and Figure 11), for an uncompensated loss of -11,623.2 AAHU's. Table 24 shows the compensation area needed in acres for these protection alternatives. Implementation of this alternative would result in the loss of 22,143 acres of upland habitat. The compensation plan indicates

Table 20. Upland form B. Baseline Habitat Suitability Index values and acres for upland evaluation elements used in the HEP analysis of the Natomas flood control alternatives.

Form B: Habitat Units
Study Name: NATOMAS - NOVEMBER 1990
Action: PA 3 (without project) NATOMAS UPLANDS
Target Year: 0

Evaluation ID#	Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
1	Great Blue Heron	1139.30	1.00	1139.30
3	Red-winged Blackbird	13907.40	0.09	1251.67
12	California Vole	2927.80	0.97	2839.97
13	Mallard (wintering)	12935.90	0.95	12289.10
14	American Kestrel	1140.50	0.85	969.43
15	Short-eared Owl	26379.90	0.90	23741.91
18	Ring-necked Pheasant	25240.50	0.43	10853.42

Table 21. Natomas upland mitigation form B. Baseline Habitat Suitability Index values and acres for upland mitigation evaluation elements used in the HEP analysis of the Natomas 200- and 400-Year Natomas flood control alternatives.

Form B: Habitat Units
Study Name: NATOMAS - NOVEMBER 1990
Action: MP 3 (without project) Upland Mitigation
Target Year: 0

Evaluation ID#	Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
1	Great Blue Heron	1711.78	1.00	1711.78
3	Red-winged Blackbird	282.58	0.10	28.26
7	Gray Squirrel	0.00	0.00	0.00
9	Western Flycatcher	0.00	0.00	0.00
12	California Vole	0.00	0.00	0.00
13	Mallard (wintering)	1700.91	0.95	1615.86
15	Short-eared Owl	282.58	0.81	228.89
18	Ring-necked Pheasant	271.71	0.50	135.85
19	California Quail	0.00	0.00	0.00
20	Acorn Woodpecker	0.00	0.00	0.00

Table 22. Natomas upland impacts. Net change in AAHUs (Form D).

Form D: Net Change in AAHU's
Study Name: NATOMAS - NOVEMBER 1990
Action: PA 4 (with project) UPLANDS W/ PROJECT
Compared To: PA 3 (without project) NATOMAS UPLANDS
Period of analysis: 102

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	Great Blue Heron	353.52	860.38	-506.86
3	Red-winged Blackbird	386.51	947.83	-561.32
12	California Vole	1317.86	2155.70	-837.84
13	Mallard (wintering)	3824.55	9271.64	-5447.09
14	American Kestrel	274.03	753.55	-479.52
15	Short-eared Owl	7704.13	17994.49	-10290.35
18	Ring-necked Pheasant	3528.84	8227.40	-4698.57

Table 23. Natomas upland mitigation site, net change in AAHU's (Form D).

Form D: Net Change in AAHU's
Study Name: NATOMAS - NOVEMBER 1990
Action: MP 12 (with project) QUAD 1 & 4 MANAGED
Compared To: MP 11 (without project) QUAD #1 & QUAD #4
Period of analysis: 102

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	Great Blue Heron	3466.09	3713.00	-246.91
2	Muskrat	1485.38	0.00	1485.38
3	Red-winged Blackbird	60.95	60.96	-0.01
4	Wood Duck	2299.39	0.00	2299.39
5	Yellow Warbler	15.77	0.00	15.77
6	Blk-shouldered Kite	176.21	0.00	176.21
7	Gray Squirrel	179.89	0.00	179.89
8	Downy Woodpecker	9.44	0.00	9.44
9	Western Flycatcher	126.53	0.00	126.53
10	Sora	2096.20	0.00	2096.20
11	Red-legged Frog	2339.96	0.00	2339.96
12	California Vole	986.19	10.28	975.90
13	Mallard (wintering)	1071.63	3614.26	-2542.63
15	Short-eared Owl	1738.58	699.27	1039.32
16	Northern Oriole	20.13	0.00	20.13
17	Mink	1987.81	0.00	1987.81
18	Ring-necked Pheasant	1229.56	298.90	930.66
19	California Quail	85.17	0.00	85.17
20	Acorn Woodpecker	220.19	0.00	220.19

11,908.61 acres would be needed to compensate for project related losses in values.

Figure 10. Upland changes in habitat units under Without- and With-Project scenarios for the Natomas 200- and 400-Year flood control alternatives. The area between the lines represents the habitat values requiring compensation.

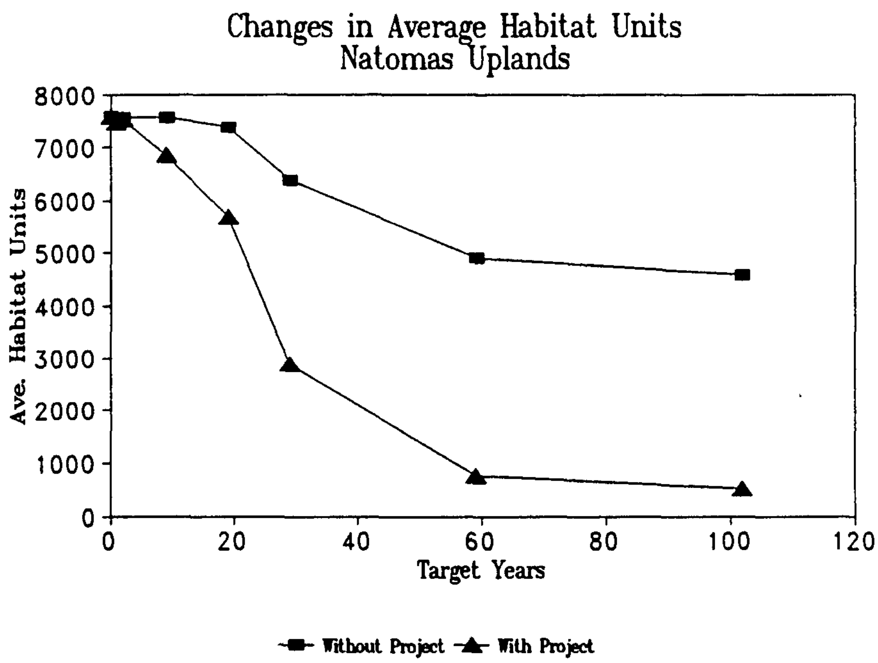


Figure 11. Changes in upland mitigation site habitat units under Without- and With-Management scenarios for the Natomas mitigation areas 1 & 4. The area between the lines represents the habitat values gained through management.

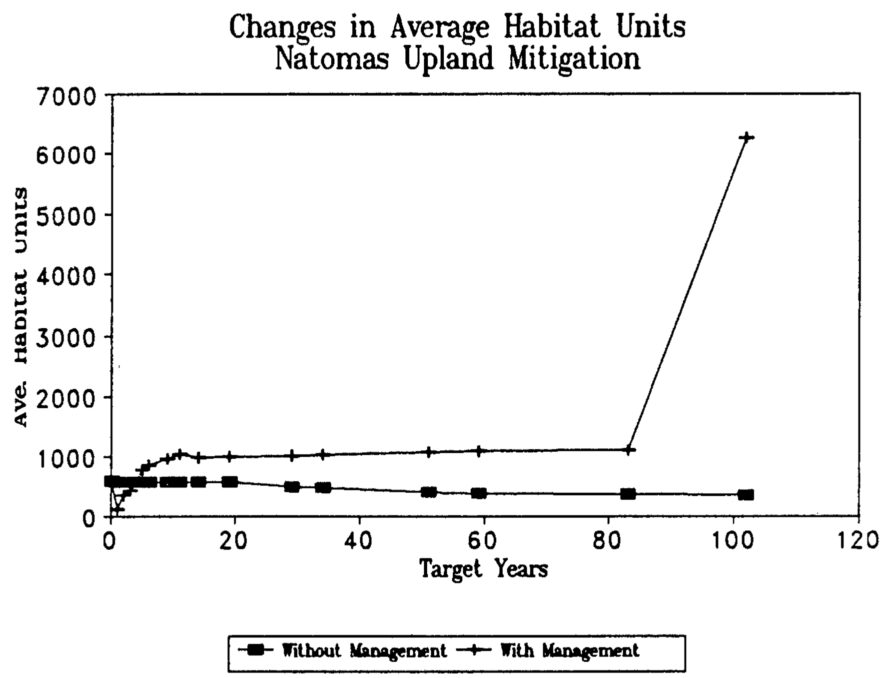


Table 24. Form H: Natomas upland impacts.

Area Needed For Equal or Relative Compensation (Form H Results)   Date: 11/30/1990

Study Name: NATOMAS - NOVEMBER 1990
Plan Alternative: PA 4 (with project) UPLANDS W/ PROJECT
Compared To: PA 3 (without project) NATOMAS UPLANDS
Management Plan: MP 12 (with project) QUAD 1 & 4 MANAGED
Compared To: MP 11 (without project) QUAD #1 & QUAD #4
Candidate Management Area Size: 5843.49
Source of Relative Value Indices: All Equal To 1.0

Evaluation Species ID#	Name	Net Change In AAHU's: Plan Alternative	Management Plan
1	Great Blue Heron	-506.86	-246.91
2	Muskrat	0.00	1485.38
3	Red-winged Blackbird	-561.32	-0.01
4	Wood Duck	0.00	2299.39
5	Yellow Warbler	0.00	15.77
6	Blk-shouldered Kite	0.00	176.21
7	Gray Squirrel	0.00	179.89
8	Downy Woodpecker	0.00	9.44
9	Western Flycatcher	0.00	126.53
10	Sora	0.00	2096.20
11	Red-legged Frog	0.00	2339.96
12	California Vole	-837.84	975.90
13	Mallard (wintering)	-5447.09	-2542.63
14	American Kestrel	-479.52	0.00
15	Short-eared Owl	-10290.35	1039.32
16	Northern Oriole	0.00	20.13
17	Mink	0.00	1987.81
18	Ring-necked Pheasant	-4698.57	930.66
19	California Quail	0.00	85.17
20	Acorn Woodpecker	0.00	220.19
	Area Needed For Compensation:		11908.61

SUMMARY AND CONCLUSIONS

The Habitat Evaluation Procedures method was used to quantify the baseline habitat conditions, and determine the impacts to terrestrial and aquatice wildllife habitats, and calculate the compensation required to offset the impacts of the proposed 200-Year or 400-Year flood control project in the Natomas basin, Sacramento and Sutter Counties, California. No real difference exists between the two alternatives in acres impacted, therefore, a single analysis was completed. The study encompassed approximately 53,000 acres, including the direct and indirect impact areas and the proposed mitigation site.

Field sampling was conducted from April to May 1989 by representatives from the U.S. Fish and Wildlife Service, California Department of Water Resources, California Department of Fish and Game, and the U.S. Army Corps of Engineers. Field sampling, impact assessment and management planning was conducted for several habitat types including palustrine emergent, palustrine scrub shrub, palustrined forested, ruderal grasslands, savanna woodlands, rice and other agricultural crops. A comprehensive mitigation plan was developed to compensate for the habitat acres and value losses associated with the flood control project. Total habitat losses were approximately 22,143 acres of upland habitat types and better than 776 acres of wetland habitat types.

The great blue heron and black-shouldered kite had the greatest in-kind compensation requirements of all evaluation species in wetland systems.

The mitigation plan calls for conversion of existing agricultural parcels to a complex of wetlands, uplands and agriculture. The plan includes two of the four identified mitigation quadrants, however, management of all four areas would be required to reach the mitigation goal appropriate to these covertypes. Compensation plans include a combination of management of existing habitats and conversion of other habitats to wetlands and uplands. New wetlands and natural uplands habitats, e.g., oak savanna, are converted primarily from agricultural lands. The total size of the mitigation area with the in-kind compensation goal is 5,781.57 acres. With equal compensation of upland losses, 11,980.61 acres wetlands, natural uplands and wildlife-oriented agricultural lands would be required. Compensation would consist of management of existing agriculture plus creation of palustrine systems and oak savanna.

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APPENDIX
H - 1

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT OFFICE
SACRAMENTO, CALIFORNIA

HABITAT EVALUATION PROCEDURE
HABITAT SUITABILITY INDEX MODELS
MICRO-HSI FORMAT
FOR
AMERICAN RIVER WATERSHED PROJECT
NATOMAS AREA
SACRAMENTO COUNTY, CALIFORNIA

by

Jini Scammell-Tinling
Fish and Wildlife Biologist

Library: B:NATOMAS.HLB
6-7-1990

Model # 1 Single covertype model.
Model name: GREAT BLUE HERON
Verification level: EXPERT REVIEW
Creation/modification date: 6-29-1989

SHORT, H. L. AND R. J. COOPER. 1985. HABITAT SUITABILITY INDEX MODELS: GREAT BLUE HERON. U.S. FISH WILDL. SERV. BIOL. REP. FWS/OBS-82/10.99. 23 PP.
Applies to treeland habitats near water as potential heronry sites, and aquatic habitats near potential heronry sites as foraging habitats.
Range: throughout the species' range in the U.S.

Covertypes:

E2AB	:	Estuarine intertidal aquatic bed
E2EM	:	Estuarine intertidal emergent wetland
E2FO	:	Estuarine intertidal forested wetland
E2SS	:	Estuarine intertidal scrub/shrub wetland
E2US/	:	Estuarine intertidal shore & bottom classes (US/RS/RF/SB)
L2	:	Lacustrine littoral subsystem
PAB	:	Palustrine aquatic bed
PEM	:	Palustrine emergent wetland
PFO	:	Palustrine forested wetland
PSS	:	Palustrine scrub/shrub wetland
PUB/	:	Palustrine shore & bottom classes (UB/RB/US)
R4	:	Riverine, intermittent
R5AB	:	Riverine aquatic bed
R5EM	:	Riverine emergent wetland
R5UB/	:	Riverine shore & bottom classes (UB/RB/SB/US/RS)
AP	:	Pasture or hayland

```
Lev 3     Lev 2     Lev 1
 X99V1----grf------usf--HSI
 X99V2----mnu-------|
 X99V3----mnu-------|
 X99V4----mnu-------|
 X99V5----mnu-------|
 X99V6----grf-------^
```

Habitat variables:

X99V1	:	Distance between potential nest sites & foraging areas (km)
X99V2	:	Pres. of water body with suitable prey pop. & forag. substr. (N=1,Y=2)
X99V3	:	Pres. of disturb.-free zone of 100m around forag. area (N=1,Y=2)
X99V4	:	Presence of treeland cover type within 250m of wetland (N=1,Y=2)
X99V5	:	Presence of 250m (land) or 150m (water) disturb.-free zone (N=1,Y=2)
X99V6	:	Proximity of potential nest site to an active nest (km)

GRAPH FUNCTION at level 2, position 1
Title: DIST. BETWEEN NEST & FORAGING SITES

```
X:      0.000,  Y:  1.000
X:      1.000,  Y:  1.000
X:     10.000,  Y:  0.100
X:     15.000,  Y:  0.100
```

```
MENU FUNCTION at level 2, position 2
     Menu choice:      1     Output value:   0.000
     Menu choice:      2     Output value:   1.000
```

```
MENU FUNCTION at level 2, position 3
     Menu choice:      1     Output value:   0.000
     Menu choice:      2     Output value:   1.000
```

```
MENU FUNCTION at level 2, position 4
     Menu choice:      1     Output value:   0.000
     Menu choice:      2     Output value:   1.000
```

```
MENU FUNCTION at level 2, position 5
     Menu choice:      1     Output value:   0.000
     Menu choice:      2     Output value:   1.000
```

```
GRAPH FUNCTION at level 2, position 6
  Title:  PROXIMITY OF POTENTIAL/ACTIVE NEST
     X:      0.000,  Y:  1.000
     X:      1.000,  Y:  1.000
     X:     20.000,  Y:  0.100
     X:     25.000,  Y:  0.100
```

```
USER-SPECIFIED FUNCTION at level 1, position 1
USUB = (X(1) * X(2) * X(3) * X(4) * X(5) * X(6))^.5
```

Comments:
AP covertype added to this model

Library: B:NATOMAS.HLB
6-7-1990

Model # 2 Single covertype model.
Model name: MUSKRAT (herbaceous wetlands)
Verification level: EXPERT REVIEW
Creation/modification date: 4-29-1987

ALLEN, A.W., AND R.D. HOFFMAN. 1984. HABITAT SUITABILITY INDEX MODELS: MUSKRAT. U.S. FISH WILDL. SERV. FWS/OBS-82/10.46. 27 PP.
Applies to year-round habitat of populations using herbaceous wetlands.
Range: throughout species range of inland freshwater habitats only.

Covertypes:
PEM : Palustrine emergent wetland
PAB : Palustrine aquatic bed
PML : Palustrine moss/lichen wetland
PUB/ : Palustrine shore & bottom classes (UB/RB/US)
PFO : Palustrine forested wetland
PSS : Palustrine scrub/shrub wetland

```
Lev 4     Lev 3     Lev 2     Lev 1
 VCVEM01--grf------gem------min--HSI
 TFRDP01--grf-------^         |
 VCVEM01--grf------gem-------^
 X46V8----grf-------^
```

Habitat variables:
TFRDP01 : Percent of year with surface water present within cover type (%)
VCVEM01 : % canopy cover of emergent herbaceous plants (pers. & non-pers.) (%)
X46V8 : % emerg. herb. veg. consisting of Olney or 3 sq. bulrush, cattail (%)

GRAPH FUNCTION at level 3, position 1
Title: % CANOPY COVER OF EMERGENT VEGETATION

X: 0.000,	Y: 0.050
X: 50.000,	Y: 1.000
X: 80.000,	Y: 1.000
X: 100.000,	Y: 0.900

GRAPH FUNCTION at level 3, position 2
Title: % OF YR. WITH SURFACE WATER PRESENT

X: 0.000,	Y: 0.000
X: 50.000,	Y: 0.000
X: 75.000,	Y: 0.100
X: 100.000,	Y: 1.000

GRAPH FUNCTION at level 3, position 3
Title: % CANOPY COVER OF EMERGENT VEGETATION

```
    X:       0.000,    Y:   0.050
    X:      50.000,    Y:   1.000
    X:      80.000,    Y:   1.000
    X:     100.000,    Y:   0.900

GRAPH FUNCTION at level 3, position 4
  Title:  % OF EMERGENT HERBACEOUS VEGETATION
    X:       0.000,    Y:   0.100
    X:      20.000,    Y:   0.100
    X:      80.000,    Y:   1.000
    X:     100.000,    Y:   1.000

Comments:
    <none>
```

Library: B:NATOMAS.HLB
6-7-1990

Model # 4 Single covertype model.
Model name: RED-WINGED BLACKBIRD (upland)
Verification level: EXPERT REVIEW
Creation/modification date: 6-29-1989

SHORT, H.L. 1985. HABITAT SUITABILITY INDEX MODELS: RED-WINGED BLACKBIRD. U.S. FISH WILDL. SERV. BIOL. REP. FWS/OBS-82/10.95. 20 PP.
Applies to nesting habitat, Mar-Jul.
Range: throughout the species' range in the 48 conterminous States.

Covertypes:
AP : Pasture or hayland
UF : Forbland
AC-ROW : not found in dictionary.
AO : Orchard (& shelterbelt)

```
Lev 3     Lev 2     Lev 1
 X95V7----mnu------gem--HSI
 X95V8----mnu-------^
```

Habitat variables:
X95V7 : Presence of dense, sturdy herb. veg. on upland site (N=1,Y=2)
X95V8 : Presence of disturbance on potential upland nesting sites (N=1,Y=2)

MENU FUNCTION at level 2, position 1

Menu choice:	1	Output value:	0.000
Menu choice:	2	Output value:	0.100

MENU FUNCTION at level 2, position 2

Menu choice:	1	Output value:	0.100
Menu choice:	2	Output value:	0.000

Comments:
AO, AC-ROW added for this study, UG deleted for this study.

Library: B:NATOMAS.HLB
6-7-1990

Model # 8 Multi-covertype model.
Model name: WOOD DUCK (year-round)
Verification level: Expert Review
Creation/modification date: 4-8-1987

SOUSA, P. J., AND A. H. FARMER. 1983. HABITAT SUITABILITY INDEX MODELS: WOOD DUCK. U.S. FISH WILDL. SERV. FWS/OBS-82/10.43. 27 pp.
Applies to areas where populations are resident throughout the year.
Range: throughout those areas where the breeding and wintering ranges overlap.

Covertypes:

PSS	: Palustrine scrub/shrub wetland
PEM	: Palustrine emergent wetland
R5EM	: Riverine emergent wetland
R4	: Riverine, intermittent
R5AB	: Riverine aquatic bed
R5UB/	: Riverine shore & bottom classes (UB/RB/SB/US/RS)
UFOD	: Deciduous Forest
PFO	: Palustrine forested wetland

LIFE REQUISITE: NESTING
Covertypes:
UFOD, PFO, PSS, PEM, R4, R5EM, R5AB, R5UB/

```
Lev 3     Lev 2     Lev 1
X43V1----usf------grf-LRSI
X43V2-----^
```

Habitat variables:

X43V1	: Density of potentially suitable tree cavities (#/ha)
X43V2	: Density of nest boxes (#/ha)

USER-SPECIFIED FUNCTION at level 2, position 1
USUB=(0.09*X(1))+(0.95*X(2))

GRAPH FUNCTION at level 1, position 1
Title: DENSITY OF POTENTIAL NEST SITES (#/HA)

X:	0.000,	Y:	0.000
X:	12.000,	Y:	1.000
X:	13.000,	Y:	1.000

Comments:
There are typographical errors in the published wood duck model: the equation for determining the density of potential nest sites should be: (0.09 * V1) + (0.95 * V2).

LIFE REQUISITE: BROOD
Covertypes:
PFO, PSS, PEM, R4, R5EM, R5AB, R5UB/

```
Lev 2     Lev 1
X43V4----grf-LRSI
```

Habitat variables:
X43V4 : % of water surface covered by potential brood cover (%)

GRAPH FUNCTION at level 1, position 1
Title: % WATER SURF. COV. BY POTENT. BROOD COV.

```
X:     0.000,   Y:   0.000
X:    50.000,   Y:   1.000
X:    75.000,   Y:   1.000
X:   100.000,   Y:   0.000
```

Comments:
<none>

LIFE REQUISITE: WINTER
Covertypes:
PFO, PSS, PEM, R4, R5EM, R5AB, R5UB/

```
Lev 2     Lev 1
X43V5----grf-LRSI
```

Habitat variables:
X43V5 : % of water surface covered by potential winter cover (%)

GRAPH FUNCTION at level 1, position 1
Title: % WATER SURF. COV. BY POTENT. WINT. COV.

```
X:     0.000,   Y:   0.000
X:    50.000,   Y:   1.000
X:    75.000,   Y:   1.000
```

```
     X:     100.000,    Y:   0.000
```

Comments:

<none>

DISTANCE FUNCTION:

```
  Title:  DISTANCE BETWEEN COVER TYPES
     X:       0.000,    Y:   1.000
     X:       0.800,    Y:   1.000
     X:       3.200,    Y:   0.000
     X:       4.000,    Y:   0.000
```

HSI TREE DIAGRAM:

```
                     Lev 4    Lev 3    Lev 2    Lev 1
                      NESTING--grf------min------max--HSI
                      BROOD----grf-------^        |
                               WINTER---usf-------^
```

GRAPH FUNCTION at level 3, position 1

```
  Title:  % EQIVALENT OPTIMUM AREA NESTING
     X:       0.000,    Y:   0.000
     X:      20.000,    Y:   1.000
     X:     100.000,    Y:   1.000
```

GRAPH FUNCTION at level 3, position 2

```
  Title:  % EQIUVALENT OPTIMUM AREA BROOD
     X:       0.000,    Y:   0.000
     X:     100.000,    Y:   1.000
```

USER-SPECIFIED FUNCTION at level 2, position 2

USUB=X(1)/100

Comments:

The distance function does not apply to the WINTER life requisite. This function applies only to distances between the NESTING and BROOD life requisites. If during HSI analysis, the program prompts for distance values involving the WINTER life requisite (either distance to a cover type providing the WINTER life requisite or distance from a cover type providing the WINTER life requisite to a cover type providing the NESTING or BROOD life requisite), a distance value of 0.0 should be entered.

Library: B:NATOMAS.HLB
6-7-1990

Model # 9 Single covertype model.
Model name: YELLOW WARBLER
Verification level: EXPERT REVIEW
Creation/modification date: 6-29-1989

SCHROEDER, R.L. 1982. HABITAT SUITABILITY INDEX MODELS:
YELLOW WARBLER. U.S. FISH WILDL. SERV. BIOL. REP.
FWS/OBS-82/10.27. 7 PP.
Applies to breeding.
Range: throughout the breeding range of the species.

Covertypes:
USHD : Deciduous shrubland
PFO : Palustrine forested wetland

```
Lev 3     Lev 2    Lev 1
 VCVSH02--grf------usf--HSI
  VHTSH05--grf-------|
  VRCSH01--grf-------^
```

Habitat variables:
VCVSH02 : Percent canopy cover of deciduous shrubs (i.e., <6m tall) (%)
VHTSH05 : Mean height of deciduous shrub canopy (not of individual shrubs) (m)
VRCSH01 : % of deciduous shrub canopy cover | hydrophytic species (%)

GRAPH FUNCTION at level 2, position 1
Title: % DECIDUOUS SHRUB CROWN COVER

X:	0.000,	Y:	0.000
X:	60.000,	Y:	1.000
X:	80.000,	Y:	1.000
X:	100.000,	Y:	0.600

GRAPH FUNCTION at level 2, position 2
Title: AVERAGE HEIGHT OF SHRUB CANOPY (M)

X:	0.000,	Y:	0.000
X:	2.000,	Y:	1.000
X:	5.000,	Y:	1.000

GRAPH FUNCTION at level 2, position 3
Title: % SHRUB CANOPY COMPRISED OF HYDROPHYTIC SHRUBS

X:	0.000,	Y:	0.100
X:	100.000,	Y:	1.000

USER-SPECIFIED FUNCTION at level 1, position 1
USUB = (X(1)*X(2)*X(3))^.5

Comments:
PSS covertype deleted for this study 6/29/89

Library: B:NATOMAS.HLB
6-7-1990

Model # 10 Single covertype model.
Model name: BLACK-SHOULDERED KITE
Verification level: Expert Review
Creation/modification date: 6-30-1989

Faanes, C.A. and R.J. Howard. 1987. Habitat suitability index models: black-shouldered kite. U.S. Fish and Wildlife Serv. Biol. Rep. 82(10.130) 13pp.

Covertypes:
PFO : Palustrine forested wetland
PSS : Palustrine scrub/shrub wetland
AP : Pasture or hayland

```
Lev 3      Lev 2     Lev 1
 AVCVGRT--usf------usf--HSI
 AVCVGRS--usf-------|
 AVCVRS---usf-------|
 AVCVeem--usf-------|
          AVCVGRT---|
          AVCVGRS---|
          AVCVRS----|
          AVCVeem---^
```

Habitat variables:
AVCVeem : % Area that is saltmarsh
AVCVGRS : % Area that is short (10-30 cm) grasses
AVCVGRT : % Area that is tall (15 - 45 cm) grasses
AVCVRS : % Area that is rushes

USER-SPECIFIED FUNCTION at level 2, position 1
USUB = X(1) * 1.0

USER-SPECIFIED FUNCTION at level 2, position 2
usub = x(1) * 0.5

USER-SPECIFIED FUNCTION at level 2, position 3
usub = x(1) * 0.3

USER-SPECIFIED FUNCTION at level 2, position 4
usub = x(1) * 0.25

USER-SPECIFIED FUNCTION at level 1, position 1
usub = (x(1)+x(2)+x(3)+x(4))/(x(5)+x(6)+x(7)+x(8))

Comments:
Assumption: Water is available in PFO, PSS, PEM, PAST where this model is applied.
PEM deleted temporarily from CT list for this study

Library: B:NATOMAS.HLB
6-7-1990

Model # 12 Single covertype model.
Model name: DOWNY WOODPECKER
Verification level: EXPERT REVIEW
Creation/modification date: 11-06-1985

SCHROEDER, R. L. 1982. HABITAT SUITABILITY INDEX MODELS:
DOWNY WOODPECKER. U.S. FISH WILDL. SERV. BIOL. REP.
FWS/OBS-82/10.38. 10 PP.
Range: throughout the species' range.

Covertypes:
E2FO : Estuarine intertidal forested wetland
PFO : Palustrine forested wetland
UFOD : Deciduous Forest
UFOE : Evergreen Forest

```
Lev 3     Lev 2     Lev 1
VBAW001--grf------min--HSI
VDNSN03--grf-------^
```

Habitat variables:
VBAW001 : Basal area of trees (if cut at 1.4m high) (m^2/ha)
VDNSN03 : Density of snags that have >15cm DBH (#/ha)

GRAPH FUNCTION at level 2, position 1
Title: BASAL AREA (M2 / HA)

X:	0.000,	Y:	0.000
X:	10.000,	Y:	1.000
X:	20.000,	Y:	1.000
X:	30.000,	Y:	0.500
X:	40.000,	Y:	0.500

GRAPH FUNCTION at level 2, position 2
Title: # SNAGS > 15 CM DBH / HA

X:	0.000,	Y:	0.000
X:	12.500,	Y:	1.000
X:	15.000,	Y:	1.000

Comments:
Density of snags rescaled to /ha.

Library: B:NATOMAS.HLB
6-7-1990

Model # 15
Model name: SORA

Single covertype model.

Verification level: Author Draft
Creation/modification date: 6-30-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - SORA. Developed from Draft model by U.S. Fish and Wildlife Service, National Ecology Research Center, Fort Collins, Colorado.

Covertypes:
E2EM : Estuarine intertidal emergent wetland
PEM : Palustrine emergent wetland

```
Lev 4     Lev 3     Lev 2     Lev 1
 WSA01----mnu------gem------usf--HSI
 WDP01----grf-------|         |
 WRE03----mnu-------^         |
 VHTHE03--grf------gem--------|
 VCVEM01--grf-------^         |
          GDIIS02--mnu-------^
```

Habitat variables:
GDIIS02 : Interspersion of Sora nest, forage and escape cove
VCVEM01 : % canopy cover of emergent herbaceous plants (pers. & non-pers.) (%)
VHTHE03 : Mean height of herbaceous canopy during spring (cm)
WDP01 : Mean water depth (m)
WRE03 : Mean water level fluctuation (m)
WSA01 : Mean salinity (ppt)

MENU FUNCTION at level 3, position 1

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.650
Menu choice:	3	Output value:	0.650

GRAPH FUNCTION at level 3, position 2
Title: Average water depth (m)

X:	0.000,	Y:	0.000
X:	0.150,	Y:	1.000
X:	0.300,	Y:	1.000
X:	0.500,	Y:	0.000

MENU FUNCTION at level 3, position 3

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.300
Menu choice:	3	Output value:	0.000

```
GRAPH FUNCTION at level 3, position 4
  Title:  Average height (cm) Herbaceous Vegn
     X:        0.000,    Y:   0.000
     X:       60.000,    Y:   1.000
     X:      200.000,    Y:   1.000

GRAPH FUNCTION at level 3, position 5
  Title:  % Cover of cattails, sedges, etc
     X:        0.000,    Y:   0.000
     X:       50.000,    Y:   1.000
     X:       75.000,    Y:   1.000
     X:      100.000,    Y:   0.250

MENU FUNCTION at level 2, position 3
     Menu choice:       1      Output value:   0.200
     Menu choice:       2      Output value:   0.700
     Menu choice:       3      Output value:   1.000

USER-SPECIFIED FUNCTION at level 1, position 1
USUB = (( X(1) * X(2))^0.5)*X(3)

Comments:
R5EM covertype removed from this model for this study.
ebd
```

Library: B:NATOMAS.HLB
6-7-1990

Model # 16 Single covertype model.
Model name: RED-LEGGED FROG
Verification level: Applied
Creation/modification date: 3-28-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - RED-LEGGED FROG. U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. NARRATIVE BY: MARK R. JENNINGS, PhD, California Academy of Sciences. Adapted from USFWS National Ecology Research Center draft model. 1988.

Covertypes:
R5EM : Riverine emergent wetland
PEM : Palustrine emergent wetland
PFO : Palustrine forested wetland
PSS : Palustrine scrub/shrub wetland

```
Lev 4     Lev 3     Lev 2     Lev 1
 HTEII01--grf------gem------min--HSI
 HTEII01--grf-------|         |
 FTIwa01--grf-------|         |
 HFLML01--mnu-------|         |
 HDPFr01--grf-------|         |
 APGz01---mnu-------^         |
 ECVEM04--grf------mea-------^
 VCVHE02--grf-------|
 HFLML02--mnu-------|
 IPF01----mnu-------|
 APGz01---mnu-------^
```

Habitat variables:
APGz01 : Grazing levels (1-none,2-light,3-moderate,4-heavy)
ECVEM04 : % of pool covered by submergent and emergent vegetation
FTIwa01 : Number of months water is present
HDPFr01 : % of water area with 7.5 - 15.2 cm deep water
HFLML01 : Mean water velocity (1 - stagnant, 2-slow, 3-rapid)
HFLML02 : Water velocity for estivation (1-stagnant,2-slow,3-rapid)
HTEII01 : Mean water temperature in littoral zone (C)
IPF01 : Presence of introduced predatory fishes
VCVHE02 : % canopy cover of herbaceous plants within 10m of wetland's edge (%)

GRAPH FUNCTION at level 3, position 1
Title: Mean Water temperature (C) (young)

X: -10.000,	Y: 0.000
X: 0.000,	Y: 0.000
X: 4.000,	Y: 1.000
X: 21.000,	Y: 1.000
X: 25.000,	Y: 0.000
X: 50.000,	Y: 0.000

```
GRAPH FUNCTION at level 3, position 2
  Title:  Mean water temperature (C)
     X:      -10.000,   Y:   0.000
     X:        0.000,   Y:   0.000
     X:        4.000,   Y:   1.000
     X:       21.000,   Y:   1.000
     X:       25.000,   Y:   0.000
     X:       50.000,   Y:   0.000


GRAPH FUNCTION at level 3, position 3
  Title:  Number of months water is present
     X:        0.000,   Y:   0.000
     X:        6.000,   Y:   1.000
     X:       12.000,   Y:   1.000


MENU FUNCTION at level 3, position 4
     Menu choice:        1       Output value:   0.800
     Menu choice:        2       Output value:   1.000
     Menu choice:        3       Output value:   0.200


GRAPH FUNCTION at level 3, position 5
  Title:  % water area w/ 7.5-15.2 cm deep water
     X:        0.000,   Y:   0.000
     X:       25.000,   Y:   1.000
     X:       75.000,   Y:   1.000
     X:      100.000,   Y:   0.750


MENU FUNCTION at level 3, position 6
     Menu choice:        1       Output value:   1.000
     Menu choice:        2       Output value:   0.800
     Menu choice:        3       Output value:   0.500
     Menu choice:        4       Output value:   0.300


GRAPH FUNCTION at level 3, position 7
  Title:  % of pool covered by submerg & emergent
     X:        0.000,   Y:   0.000
     X:       50.000,   Y:   1.000
     X:       75.000,   Y:   1.000
     X:      100.000,   Y:   0.500


GRAPH FUNCTION at level 3, position 8
  Title:  % herb cover on streambank & pond margin
     X:        0.000,   Y:   0.000
     X:       75.000,   Y:   1.000
     X:      100.000,   Y:   1.000
```

MENU FUNCTION at level 3, position 9

Menu choice:	1	Output value:	0.100
Menu choice:	2	Output value:	1.000
Menu choice:	3	Output value:	0.300

MENU FUNCTION at level 3, position 10

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	0.000

MENU FUNCTION at level 3, position 11

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.800
Menu choice:	3	Output value:	0.500
Menu choice:	4	Output value:	0.300

Comments:
IPF01 1- sunfishes and catfishes absent
2- sunfishes and catfishes present and water covered by >= 25% submergent and emergent vegetation
3- sunfishes and catfishes present and water covered by < 25% submergent and emergent vegetation

Library: B:NATOMAS.HLB
6-7-1990

Model # 17 Single covertype model.
Model name: CALIFORNIA VOLE

Verification level: Applied
Creation/modification date: 3-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - CALIFORNIA VOLE (Microtus californicus). U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. 1988.

Covertypes:
UG : Grassland
PEM : Palustrine emergent wetland
PAB : Palustrine aquatic bed
PSS : Palustrine scrub/shrub wetland

```
Lev 3     Lev 2     Lev 1
VHTHE01--grf------mea--HSI
VCVHE01--grf-------|
SS001----mnu-------^
```

Habitat variables:
SS001 : Soil moisture class (1=moist-saturated,2=moist,3=dry, see lex)
VCVHE01 : Percent canopy cover of herbs (non-woody plants: grasses & forbs) (%)
VHTHE01 : Mean height of herbaceous canopy (not of individual plants) (cm)

GRAPH FUNCTION at level 2, position 1
Title: Height of Herbaceous Vegetation

X:	0.000,	Y:	0.000
X:	5.000,	Y:	0.500
X:	10.000,	Y:	0.800
X:	15.000,	Y:	1.000
X:	20.000,	Y:	1.000

GRAPH FUNCTION at level 2, position 2
Title: Percent Cover of Herbaceous Vegetation

X:	0.000,	Y:	0.000
X:	10.000,	Y:	0.100
X:	40.000,	Y:	0.300
X:	60.000,	Y:	0.600
X:	100.000,	Y:	1.000

MENU FUNCTION at level 2, position 3

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	0.200

Comments:

SS001 - Soil type

1 - soil type is silty or loamy AND friable

2 - soil type is not silty or loamy and moderately friable

3 - soil type is not silty or loamy and is not friable

Library: B:NATOMAS.HLB
6-7-1990

Model # 19 Single covertype model.
Model name: MALLARD - WINTERING
Verification level: Applied
Creation/modification date: 6-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - MALLARD (WINTERING). U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO CALIFORNIA. 1986.

Covertypes:
RICE : Rice

```
Lev 4     Lev 3     Lev 2     Lev 1
 LGRwi01--mnu------gem------prd--HSI
 HDPwa01--grf-------|        |
 HREag01--mnu-------^        |
          GDIwl01--grf-------^
```

Habitat variables:
GDIwl01 : Distance (km) to mallard resting cover (marshes w/min 5-15% emerg/wd)
HDPwa01 : % Cropfield covered by water (2.54cm - 45cm) October - February
HREag01 : Flooding frequency 1-annually,2-most years,3-irregularly,4-never
LGRwi01 : Overwinter cropland management

MENU FUNCTION at level 3, position 1
Menu choice: 1 Output value: 1.000
Menu choice: 2 Output value: 0.700
Menu choice: 3 Output value: 0.200

GRAPH FUNCTION at level 3, position 2
Title: % cropland w/ 2.54-45cm water Oct-Feb
X: 0.000, Y: 0.000
X: 100.000, Y: 1.000

MENU FUNCTION at level 3, position 3
Menu choice: 1 Output value: 1.000
Menu choice: 2 Output value: 0.800
Menu choice: 3 Output value: 0.500
Menu choice: 4 Output value: 0.300

GRAPH FUNCTION at level 2, position 2
Title: Distance (km) to Mallard resting cover
X: 0.000, Y: 1.000

```
X:        8.000,    Y:   0.500
X:       20.000,    Y:   0.500
```

Comments:
Restore GRAIN covertype to model for other studies

Library: B:NATOMAS.HLB
6-7-1990

Model # 21 Single covertype model.
Model name: SHORT-EARED OWL (Grassland)
Verification level: Applied
Creation/modification date: 3-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - SHORT-EARED OWL. U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. 1986.

Covertypes:
UG : Grassland

```
Lev 5     Lev 4     Lev 3     Lev 2     Lev 1
 VHTHE01--grf------gem------prd------min--HSI
 VCVHE01--grf-------^        |        |
          GDIHE01--grf-------^        |
 VCVHE01--grf------gem------prd-------^
 ECVHE03--grf-------|        |
 ECVHE03--grf-------^        |
          GDIHE02--grf-------^
```

Habitat variables:
ECVHE03 : % Herbaceous cover Avena, Lolium, Bromus, Picris
GDIHE01 : Distance (km) to herbaceous cover averaging 60 - 90cm tall
GDIHE02 : Distance (km) to herbaceous vegetation 40-75% cover
VCVHE01 : Percent canopy cover of herbs (non-woody plants: grasses & forbs) (%)
VHTHE01 : Mean height of herbaceous canopy (not of individual plants) (cm)

GRAPH FUNCTION at level 4, position 1
Title: Average height of herbaceous vegn (cm)
X: 0.000, Y: 0.000
X: 61.000, Y: 1.000
X: 92.000, Y: 1.000
X: 152.000, Y: 0.000
X: 200.000, Y: 0.000

GRAPH FUNCTION at level 4, position 2
Title: Percent herbaceous cover
X: 0.000, Y: 0.000
X: 60.000, Y: 1.000
X: 100.000, Y: 1.000

GRAPH FUNCTION at level 4, position 4
Title: Percent herbaceous cover (forage)
X: 0.000, Y: 0.000

```
    X:      40.000,   Y:   1.000
    X:      75.000,   Y:   1.000
    X:     100.000,   Y:   0.200

GRAPH FUNCTION at level 4, position 5
  Title:  % Cover Ca Vole preferred herb spp.
    X:       0.000,   Y:   0.500
    X:      70.000,   Y:   1.000
    X:     100.000,   Y:   1.000

GRAPH FUNCTION at level 4, position 6
  Title:  % Ca Vole preferred herbaceous plants
    X:       0.000,   Y:   0.500
    X:      70.000,   Y:   1.000
    X:     100.000,   Y:   1.000

GRAPH FUNCTION at level 3, position 2
  Title:  Distance (km) roost cover (herb 60-90cm)
    X:       0.000,   Y:   1.000
    X:       5.600,   Y:   0.100
    X:      10.000,   Y:   0.100

GRAPH FUNCTION at level 3, position 4
  Title:  Distance to forage site (40-75% herb)
    X:       0.000,   Y:   1.000
    X:       5.630,   Y:   0.100
    X:      10.000,   Y:   0.100

Comments:
    <none>
```

Library: B:NATOMAS.HLB
6-7-1990

Model # 22 Single covertype model.
Model name: NORTHERN ORIOLE
Verification level: Applied
Creation/modification date: 3-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - NORTHERN ORIOLE. U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. 1986.

Covertypes:
PFO : Palustrine forested wetland
UTSD : Deciduous tree savanna

```
Lev 3     Lev 2     Lev 1
VHTDE01--grf------gem--HSI
ECVTR01--grf-------|
GWLTR01--mnu-------^
```

Habitat variables:
ECVTR01 : Percent deciduous tree crown cover
GWLTR01 : Stand Width 1- narrow, one tree,2- < 300 ft, 3 - > 300 ft at widest
VHTDE01 : Mean height of deciduous trees (m)

GRAPH FUNCTION at level 2, position 1
Title: Average height deciduous tree canopy (m)

X:	0.000,	Y:	0.000
X:	10.000,	Y:	1.000
X:	15.000,	Y:	1.000

GRAPH FUNCTION at level 2, position 2
Title: % Deciduous tree crown cover

X:	0.000,	Y:	0.000
X:	25.000,	Y:	1.000
X:	50.000,	Y:	1.000
X:	100.000,	Y:	0.750

MENU FUNCTION at level 2, position 3

Menu choice:	1	Output value:	0.200
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	1.000

Comments:
<none>

Library: B:NATOMAS.HLB
6-7-1990

Model # 23 Single covertype model.
Model name: MINK (for. & shr. wetl. <405)
Verification level: EXPERT REVIEW
Creation/modification date: 4-29-1987

FORESTED AND SHRUB WETLANDS < 405 HA (1000 AC) IN SIZE
ALLEN, A. W. 1984. HABITAT SUITABILITY INDEX MODELS: MINK, REVISED.
U.S. FISH WILDL. SERV. BIOL. REP. 82(10.127). 23 PP.
[First printed as: FWS/OBS-82/10.61, October 1983.]
Applies to year-round habitat of forested and shrub wetland populations in wetlands less than 405 ha (1000ac).
Range: throughout the historic range of the species in North America.

Covertypes:
PFO : Palustrine forested wetland
PSS : Palustrine scrub/shrub wetland

```
Lev 3      Lev 2      Lev 1
 VCVTR05--grf------usf--HSI
 TFRDP01--grf-------|
 VCVWO02--grf-------^
```

Habitat variables:
TFRDP01 : Percent of year with surface water present within cover type (%)
VCVTR05 : % canopy cover of trees, shrubs & persistent emergent herbs (%)
VCVWO02 : % canopy cover of trees & shrubs within 100m of wetland's edge (%)

GRAPH FUNCTION at level 2, position 1
Title: % CANOPY CLOSURE

X:	0.000,	Y:	0.000
X:	75.000,	Y:	1.000
X:	100.000,	Y:	1.000

GRAPH FUNCTION at level 2, position 2
Title: % OF YEAR WITH SURFACE WATER PRESENT

X:	0.000,	Y:	0.000
X:	25.000,	Y:	0.000
X:	75.000,	Y:	1.000
X:	100.000,	Y:	1.000

GRAPH FUNCTION at level 2, position 3
Title: % CANOPY CLOSURE WITHIN 100 M OF WATER

X:	0.000,	Y:	0.100
X:	75.000,	Y:	1.000
X:	100.000,	Y:	1.000

```
USER-SPECIFIED FUNCTION at level 1, position 1
USUB = ((X(1)+X(3))/2)*X(2)

Comments:
     <none>
```

Library: B:NATOMAS.HLB
6-7-1990

Model # 26 Single covertype model.
Model name: SHORT-EARED OWL (Pasture)
Verification level: Applied
Creation/modification date: 3-29-1989

DRAFT HABITAT SUITABILITY INDEX MODEL - SHORT-EARED OWL. U.S. FISH AND WILDLIFE SERVICE, DIVISION OF ECOLOGICAL SERVICES, SACRAMENTO, CALIFORNIA. 1986. Adapted in part from draft National Ecology Research Center model.

Covertypes:
AP : Pasture or hayland

```
Lev 4     Lev 3     Lev 2     Lev 1
 ALFbait--usf------usf------prd--HSI
 CLVRbat--usf-------|        |
          ALFacre---|        |
          CLVRac----^        |
          GDIHE01--grf-------^
```

Habitat variables:
ALFacre : Total acreage of alfalfa in County
ALFbait : % of County alfalfa baited for Microtus
CLVRac : Total acreage of Clover in County
CLVRbat : % of County clover which is baited for microtus
GDIHE01 : Distance (km) to herbaceous cover averaging 60 - 90cm tall

USER-SPECIFIED FUNCTION at level 3, position 1
USUB = 1 - (X(1)/100)

USER-SPECIFIED FUNCTION at level 3, position 2
USUB = 1- (X(1)/100)

USER-SPECIFIED FUNCTION at level 2, position 1
USUB = ((X(1)*X(3)) + (X(2)*X(4)))/(X(3)+X(4))

GRAPH FUNCTION at level 2, position 2
Title: Distance (km) roost cover (herb 60-90cm)

X:	0.000,	Y:	1.000
X:	5.600,	Y:	0.100
X:	10.000,	Y:	0.100

Comments:
<none>

Library: B:NATOMAS.HLB
6-7-1990

Model # 27 Single covertype model.
Model name: SHORT-EARED OWL (Grain & Row)
Verification level: Applied
Creation/modification date: 6-29-1989

Covertypes:
GRAIN : Grain
AC-ROW : Cropland - row crop

```
Lev 5     Lev 4     Lev 3     Lev 2     Lev 1
 VHTHE01--grf------gem------prd------min--HSI
 VCVHE01--grf-------^         |         |
           GDIHE01--grf-------^         |
           LGRwi01--mnu------prd-------^
           GDIHE02--grf-------^
```

Habitat variables:
GDIHE01 : Distance (km) to herbaceous cover averaging 60 - 90cm tall
GDIHE02 : Distance (km) to herbaceous vegetation 40-75% cover
LGRwi01 : Overwinter cropland management
VCVHE01 : Percent canopy cover of herbs (non-woody plants: grasses & forbs) (%)
VHTHE01 : Mean height of herbaceous canopy (not of individual plants) (cm)

GRAPH FUNCTION at level 4, position 1
Title: Average height herbaceous vegn (cm)

X: 0.000,	Y: 0.000
X: 61.000,	Y: 1.000
X: 92.000,	Y: 1.000
X: 152.000,	Y: 0.000
X: 200.000,	Y: 0.000

GRAPH FUNCTION at level 4, position 2
Title: Percent herbaceous cover

X: 0.000,	Y: 0.000
X: 60.000,	Y: 1.000
X: 100.000,	Y: 1.000

GRAPH FUNCTION at level 3, position 2
Title: Distance (km) roost cover (herb 60-90cm)

X: 0.000,	Y: 1.000
X: 5.600,	Y: 0.100
X: 10.000,	Y: 0.100

MENU FUNCTION at level 3, position 3

Menu choice:	4	Output value:	0.000
Menu choice:	5	Output value:	0.250
Menu choice:	6	Output value:	1.000
Menu choice:	7	Output value:	0.250

GRAPH FUNCTION at level 3, position 4

Title: Distance (km) forage site (40-75% herb)

X:	0.000,	Y:	1.000
X:	5.630,	Y:	0.100
X:	10.000,	Y:	0.100

Comments:

<none>

Library: B:NATOMAS.HLB
6-7-1990

Model # 28 Single covertype model.
Model name: RING-NECKED PHEASANT (Breed)
Verification level: Author Draft
Creation/modification date: 6-29-1989

HABITAT SUITABILITY INDEX MODEL - RING-NECKED PHEASANT (Nest/Brood Cover). 1988. Carolyn B. Mayer, U.S. Fish & Wildlife Service. Pierre, South Dakota.

Covertypes:

AC	:	Cropland
AC-ROW	:	Cropland - row crop
GRAIN	:	Grain
UG	:	Grassland
UF	:	Forbland
UFOD	:	Deciduous Forest
USHD	:	Deciduous shrubland
USSD	:	Deciduous Shrub Savanna
PEMA	:	Palustrine emergent which is temporarily flooded
PEMF	:	Palustrine emergent which is semi-permanently flooded
PSS	:	Palustrine scrub/shrub wetland

```
Lev 3    Lev 2    Lev 1
 EHD01----grf------prd--HSI
 LAPAP02--mnu-------^
```

Habitat variables:
EHD01 : Mean visual obstruction (VOR) (dm)
LAPAP02 : Harvest Practices

GRAPH FUNCTION at level 2, position 1
Title: Mean Visual Obstruction (dm)

X:	0.000,	Y:	0.000
X:	0.500,	Y:	0.100
X:	2.000,	Y:	1.000
X:	20.000,	Y:	1.000

MENU FUNCTION at level 2, position 2

Menu choice:	1	Output value:	1.000
Menu choice:	2	Output value:	0.500
Menu choice:	3	Output value:	0.200
Menu choice:	4	Output value:	0.100

Comments:
LAPAP02
1 - unharvested cover, other than small grains
2 - cover harvested, but not from April 15 - July 15, and is not

small grain
3 - small grain
4 - Cover harvested between April 15 and July 15
Restore AP, and UTSD to covertypes for other studies.